Chapter 3
Affected Environment and Environmental Consequences

This chapter summarizes the physical, biological, social, and economic environments of the project area and the effects of implementing each alternative on that environment. It also presents the scientific and analytical basis for the comparison of alternatives presented in Chapter 2.

Past, Present, and Foreseeable Future Actions Considered in Cumulative Effects

"Cumulative impact" is defined (40 CFR 1508.7) as the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of the source. An individual action when considered alone may not have a significant effect, but when its effects are considered together with the effects of other past, present, and reasonably foreseeable future actions, the effects may be significant. Cumulative impacts (effects) can result from individually minor but collectively significant actions taking place over a period of time. If the action has some direct or indirect effect on any given resource, no matter how minor, then a cumulative effects analysis for that resource is necessary.

The cumulative effects analysis in this Final Environmental Impact Statement is consistent with Forest Service National Environmental Policy Act (NEPA) Regulations (36 CFR 220.4(f)) (July 24, 2008), which state, in part:

> "CEQ regulations do not require the consideration of the individual effects of all past actions to determine the present effects of past actions. Once the agency has identified those present effects of past actions that warrant consideration, the agency assesses the extent that the effects of the proposal for agency action or its alternatives will add to, modify, or mitigate those effects. The final analysis documents an agency assessment of the cumulative effects of the actions considered (including past, present, and reasonable foreseeable future actions) on the affected environment. With respect to past actions, during the scoping process and subsequent preparation of the analysis, the agency must determine what information regarding past actions is useful and relevant to the required analysis of cumulative effects. Cataloging past actions and specific information about the direct and indirect effects of their design and implementation could in some contexts be useful to predict the cumulative effects of the proposal. The CEQ regulations, however, do not require agencies to catalogue or exhaustively list and analyze all individual past actions. Simply because information about past actions may be available or obtained with reasonable effort does not mean that it is relevant and necessary to inform decisionmaking. (40 CFR 1508.7)"

The projects listed below either overlap the Freds Fire Reforestation Project area or are adjacent it. Each resource has identified which of these projects (and others depending on the resource cumulative effects analysis area) that contribute cumulative impacts and analyzed those effects.

The following is a list of projects that are within or adjacent to the Freds Fire:

By far the greatest impact on the environment has been from the Freds Fire and subsequent salvage of fire killed trees. The Freds Fire affected, and has the potential to continue to affect soils, water quality, wildlife habitat, cultural resources, and vegetation.

Past fire occurrences in the South Fork of American River Canyon have impacted the environment in and adjacent the Freds Fire. Historic fire occurrences within 2.5 miles of the South Fork of American River, from Riverton to Horsetail Falls (23 miles) show 5 large (> 3,000 acres) stand-replacing fires have occurred since 1959 (Ice House 1959 -19,000 acres, Pilliken 1973 – 10,000 acres, Wrights 1981- 3,800 acres, Cleveland 1992 – 24,000 acres, and Freds).

Sierra Pacific Industries (SPI) and four individuals own land within the fire area (see Figure 1-1 in Chapter 1). A total of 2,850 acres of SPI land burned within the Freds Fire perimeter. SPI has completed logging and is in the reforestation process. SPI has planted trees on approximately 2,526 acres. These planted acres on SPI land have had herbicide treatments with hexazinone (1,000 acres) and glyphosate (1,526 acres) (Barr, personal communication, 2009).

The Eldorado National Forest has planted about 1,868 acres within the project area. These planted trees were hand released the year of planting.

Invasive Plants - The Yellow Starthistle Project involves treatments to control yellow starthistle on the Forest. In the vicinity of the Freds fire, treatments are ongoing along Webber Mill road (11N38) from Soda Springs–Riverton Road (17N12) and into the Freds fire area. Herbicides being used are clopyralid and glyphosate. Tall whitetop is currently being tarped.

Roadrunner Fuels Reduction project – fuels reduction activities on approximately 192 acres in the vicinity of Highway 50 on the Placerville Ranger District. The activities include removal of dead and dying hazard trees, understory thinning involving the cutting and removal of both commercial and non-commercial sized trees, mastication, tractor piling and pile burning, hand felling and piling, and pruning.

Misnomer Fuels Reduction project – located near Atherton Flat in T11N, T12N; R15E and R16E, MDB&M. This project includes fuel reduction activities include a combination of understory burning, understory thinning involving the cutting and removal of both commercial and non-commercial sized trees, mastication, tractor piling and pile burning on approximately 989 acres. Harvest is complete and tractor piling has been completed on about 800 acres. Remaining tractor piling, pile burning, and follow-up prescribed burning is scheduled for completion within 1 to 4 years.

Ongoing recreation use of portions of the fire area include:

Construction, reconstruction, maintenance and use of the Pony Express Trail by non-motorized recreationists.

Continued use of recreation residence tracts just south of the fire (29, 30, 31, 33, and 34 Milestone Tracts).

Dispersed camping, especially near Granite Springs.

State managed hunting opportunities (Dear Hunt Zone D5) and fishing in the South Fork of the American River.

Public firewood gathering.

Fire and Fuels

Affected Environment

The project area is primarily within the upper- and mid-montane zones. There are approximately 1,143 acres of upper montane, which varies from pure red fir to mixtures of red fir and white fir or lodgepole pine. Rocky areas are more prevalent than in other zones and are typically dominated by Jeffrey pine and various amounts of evergreen shrubs. Greenleaf manzanita, huckleberry oak and pinemat manzanita are the prevalent shrub species. There are approximately 2,381 acres of mid-montane zone, which consists of a narrow band above 5,000 feet elevation dominated by white fir and Jeffrey pine between the lower montane and upper montane zones. The vegetation varies considerably from mixed conifer to pure white fir forests, with the common element that white fir is generally a co-dominant or dominant. Sugar pine and incense cedar are commonly present. Douglas-fir is absent or present in low amounts. Red fir may be present in low amounts. Extensive areas, particularly with rocky or shallow soils may be dominated by or intermixed with evergreen shrubs. Huckleberry oak and greenleaf manzanita are the primary shrubs.

The remaining 288 acres of the project area are in the lower montane zone. This zone is characterized by ponderosa pine, black oak, and live oak forests with interspersed chaparral. Above 4,000 feet, white fir occurred historically intermixed with Douglas-fir. Large areas with black oak as a dominant or co-dominant occur in this zone, particularly on ridges or upper slopes or south or west aspects. In this zone, as elevation increases, historic fires increasingly varied with aspect and/or topographic position.

Fire risk is the chance, or probability, that a wildfire will start, either from natural or human causes, based on recent fire history. Fire hazard is determined by the characteristics of fuels combined with the influences of topography and weather. The fuels characteristics apply to both dead and live fuels, and include loading (tons per acre), size and shape, compactness, horizontal continuity, vertical arrangement, fuel moisture content, and chemical properties. Topographic and weather influences, combined with fuels characteristics, determine the rate of forward spread of a fire and the intensity at which a fire will burn. The project area is currently in an area predominantly classified as extreme fire risk and very high fire hazard as determined by analysis of the Eldorado National Forest Fire Risk by watershed and the Eldorado National Forest Fire Hazard Map (ENF 1996).

Fire regimes are comprised of patterns of fire frequency, intensity, severity, seasonality, predictability, and spatial patterns over time across landscapes (Agee 1993). In the Sierra Nevada, fire regimes varied historically across the landscape with elevation, precipitation, aspect, topographic position, soil conditions or site productivity, and vegetation (Skinner and Chang 1996, Fites-Kaufman 1997, Fites-Kaufman et al. 2000).

Fire patterns can vary by individual watershed or landscape, even if they have similar vegetation. For example fire characteristics can vary with how the landscape is oriented relative to prevailing wind patterns. Drainages that are aligned with prevailing wind patterns will have more frequent, or larger, or more intense fires than those that are sheltered from prevailing winds. Rarely do we have fire history data for each landscape component but generalizations on fire regimes can be made based on similar landscape topography and vegetation. Fire history research has been compiled from all parts of the Sierra Nevada and southern Cascade mountains by vegetation type and landscape conditions that allow us to describe general historic fire regime patterns for the northern Sierra Nevada.

Fire history from the Caribou wilderness of the Lassen National Forest and Lassen National Park, in Jeffrey pine-white fir forests (Solem 1995), is generally representative of conditions in the project area. Fire return intervals there ranged from 23 to 32 years. Precipitation at the Lassen sites is less than 100 centimeters per year. Precipitation in the northern Sierra is greater than 150 centimeters per year, which may better represent precipitation in the project area. The fire return intervals in upper montane forests that have more similar precipitation are most often greater than 40 years (Solem 1995, Taylor and Halpern 1991). For the project area, fire return intervals were probably somewhere in between and tending to the higher end.

Research on historic fire intensity and severity is lacking in this zone but white fir dominated types are thought to burn with mixed severity, like the similar upper montane red fir, but with a greater component of low severity fires. The pattern would be mostly low intensity fires that are often patchy. At varied intervals associated with dry years, more intense fires likely occurred that resulted in a patchwork of low, medium, and high severity areas across the landscape. It is difficult to find much research on historic patterns of fire extent and spread for the Sierra Nevada. Wildland fire use in the upper montane portion of Yosemite National Park suggests that fires were often limited in size by recent adjacent burned patches.

Historic fire occurrence data exists for this area of the Eldorado National Forest (ENF). The fireshed for this analysis is defined as: a strip of land paralleling the South Fork American River and extending north and south 2.5 miles on either side. It extends from the west where the river begins to parallel Highway 50 to approximately 23 miles east to the area of Horsetail Falls. This area encompasses approximately 78,642 acres. This analysis is summarized in Table 3-1.

Table 3-1. Fire Summary of Recent Fire History

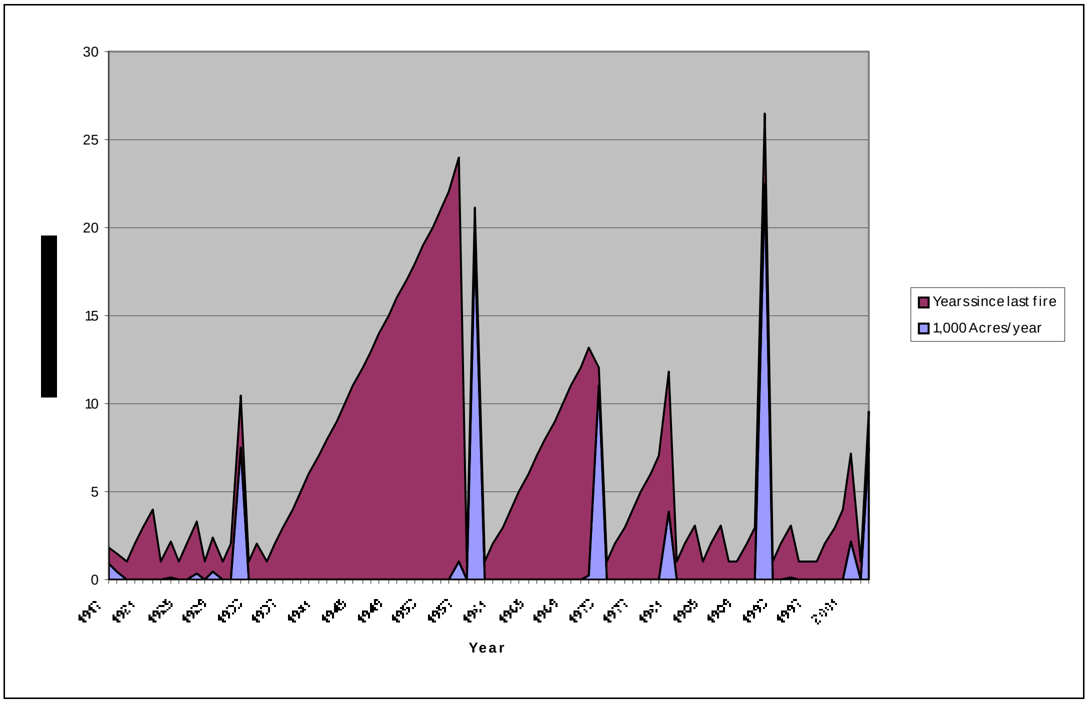
Size Class	Class C +	Class D +	Class E +	Class F +	Class G +
Acreage Range	10 acres or more	100 acres or more	300 acres or more	1,000 acres or more	5,000 acres or more
Fire Return Interval	4 year	7 years	8 years	10 years	18 years
Number of years with multiple fire occurrence	10 years	5 years	2 years	No	No
Percent Chance of Occurrence	41%	20%	13%	8%	5%

Note: Only the acreage burned within the fire shed was counted and may have reduced the size class of the actual fire.

Records for Class C (10 acres or larger) fires start in 1908. The first year with a recorded Class C fire in the American River Canyon is 1916 (refer to Figure 3-1). There were two fires, with acreages of approximately 30 acres and 775 acres. The period ends in 2004 with the Freds Fire. During this time period 40 Class C or greater fires have burned in the canyon. Approximately 61 percent of the fireshed has burned at least once during this time period and 12 percent has burned at least twice. On average, 805 acres burn each year. Based on fire history for this time period there is a 41 percent chance that there will be a C class or larger fire in this canyon in any given year. Since 1959, there have been at least 5 class E (300 acres or larger) fires that have had a significant portion of them burn as a stand-replacing event. This time period can also be used to determine recent fire return intervals for different size classes of fires.

Records for Size Class A and B (less than 10 acres) exist for the period from 1970 to 2003. During this time period there were 399 Class A or Class B fires and 17 Class C fires in the area. Based on this data there are an average of 12 fire starts per year. There is one Class C or larger fire every two years.

Figure 3-1. Historic Fire Intervals and Acres (1,000) Burned per Year



Recent fire history indicates that C Class and larger fires can be broken into three periods: During the first period, 1916 to 1934, the average fire return interval is 2.4 years; the period averaged 553 acres burned per year with an average fire size of approximately 1,200 acres.

During the second period, 1935 to 1981, the average fire return interval is 9.4 years; 750 acres per year burned and the average fire size was 7,047 acres. Between 1935 and 1957 no C Class or larger fires are recorded. After this twenty-three year break there was a fire that burned over one thousand acres in the fireshed; it was followed two years later by the Ice House fire, which burned approximately nineteen thousand acres. The next C Class fires occurred after 13 years, in 1972 and 1973. They burned 200 and 11,000 acres, respectively. The next C Class fire to occur was the Wrights fire, eight years later (1981).

In the third period, 1982 to the present, the average fire return interval is three years, the average acres burned per year is 1,408, and the average fire size is 3,597 acres.

Highway 50 has been a relatively heavily used section of road for more than 100 years. There have been roadhouses and stage stops located in the canyon through out this time period. In the 1930’s when the Civilian Conservation Corps began work on the forest, it provided a readily deployable fire suppression force. Little evidence of the logging history in the canyon could be found, but it can be surmised that, given the steepness of the terrain, little logging occurred except along the ridges and flatter areas on the slope. These flatter areas were probably intensively harvested. Given this history the change in periodicy generally fits the theory that the effects of fire suppression have altered fire return intervals. The first period can be viewed as one of fairly frequent fires. The second period can be viewed as one of fairly effective fire control, with fewer fires reaching the Class C and greater size and those occurring at greater intervals. The third period can be viewed as a breakdown in the system.

After the completion of salvage on the Freds Fire Restoration Project, surface fuels present were predicted to consist of the following approximate tonnage in each of the size classes (Table 3-2):

Table 3-2. Approximate Residual Fuel after Completion of Freds Fire Restoration Project

Fuel Type	Fuel Size	Fuel Quantity (tons per acre)
1-hour	0” to ¼”	0.4
10-hour	¼” to 1”	1.15
100-hour	1” to 3”	1.5
1,000-hour	> 3”	5.0 (not including snags/logs left for old forest structure and wildlife)

The fuels were distributed as evenly as practical, providing sufficient ground cover (50%-60%) for soil protection purposes. This combination is low enough so that the accumulation of additional surface fuels from the predicted snag fall of the snags left standing for wildlife and watershed purposes would not present a large fuels buildup over time and contribute to fire suppression difficulties.

Following the fire deer brush (*Ceanothus integerrimus*), bearclover (*Chamaebatia foliolosa*), manzanita (*Arctostaphylus spp*), whitethorn (*Ceanothus cordulatus*) and various grasses have become the major species established. These brush species have the potential to almost fully occupy the site as evidenced from portions of the Cleveland fire (e.g. untreated drainages, untreated blocks, treatment demonstration areas, south of the American River canyon).

The Fire Effects Information System (USDA 2008a) described plant response to fire as follows:

“After soil-stored seed is scarified by fire, deer brush seedlings establish in great numbers. Most seedlings establish in the first postfire growing season. Natural thinning reduces seedling density as the stand ages. After a July 1942 wildfire consumed a deer brush stand on the El Dorado National Forest, deer brush density was about 300,000 seedlings per acre at postfire year 1; 10,000 per acre at postfire year 10; 2,500 at postfire year 20; and less than a few hundred seedlings at postfire year 30.”

Bearclover recovers rapidly from disturbance and tends to form dense stands, its very presence tends to lower species richness quickly (McDonald et al 2004). In areas where bearclover is present it may out-compete grass and other brush species.

Environmental Consequences

Direct, indirect and cumulative effects for fire behavior and fuels consider the impacts of the alternatives when combined with the following past, present, and foreseeable future actions and events: Vegetative and fuel bed changes resulting from the fire. The actions contributing to cumulative effects were selected because they have caused or have the potential to cause changes in fire intensity and severity, fire hazard and resistance to control. The geographic scope of the cumulative effects analysis was selected because impacts to fuels and fire behavior accumulate at a given location on the ground, irrespective of actions in surrounding areas. The temporal scope was selected because the impacts to fuels and fire behavior at a given location can accumulate over time from different activities or events.

Alternative 1 (Proposed Action)

Direct Effects

Based on First Order Fire Effects Model analysis, small conifers have little fire resilience, even under mild burning conditions (flame lengths of four feet or less). It isn’t until they reach 6 to 10 inches diameter at breast height (DBH) that the probability of mortality is 50 percent or less (Tables 3-3a, 3-3b, 3-3c).

Table 3-3a. Predicted of Mortality for a 2 Foot Flame Length

DBH (in) (cm)	Ponderosa Pine	Jeffery Pine	Sugar Pine	Douglas Fir	Incense Cedar	White Fir	Red Fir
2 5.1	98%	98%	98%	98%	98%	98%	98%
4 10.2	63%	61%	59%	63%	64%	70%	74%
6 15.2	49%	46%	43%	49%	51%	59%	65%
8 20.3	36%	33%	30%	36%	39%	48%	56%
10 25.4	27%	24%	21%	27%	29%	39%	48%

Table 3-3b. Predicted of Mortality for a 4 Foot Flame Length

DBH (in) (cm)	Ponderosa Pine	Jeffery Pine	Sugar Pine	Douglas Fir	Incense Cedar	White Fir	Red Fir
2 5.1	100%	100%	100%	100%	100%	100%	100%
4 10.2	100%	100%	100%	100%	100%	100%	100%
6 15.2	97%	97%	97%	97%	98%	98%	99%
8 20.3	52%	48%	45%	52%	54%	63%	70%
10 25.4	27%	24%	21%	27%	29%	39%	48%

Table 3-3c. Predicted of Mortality for a 6 Foot Flame Length

DBH (in) (cm)	Ponderosa Pine	Jeffery Pine	Sugar Pine	Douglas Fir	Incense Cedar	White Fir	Red Fir
2 5.1	100%	100%	100%	100%	100%	100%	100%
4 10.2	100%	100%	100%	100%	100%	100%	100%
6 15.2	100%	99%	99%	100%	100%	100%	100%
8 20.3	99%	99%	99%	99%	99%	99%	100%
10 25.4	92%	91%	90%	92%	93%	95%	97%

This is confirmed by the study done on Blodgett Forest Reserve (Stephens and Moghadas 2005). In this study the average DBH for plantation trees was less than 10 inches and the probability of mortality for these size classes were greater than 90 percent for all weather sets. Thus, the issue with the survivability of plantations is not the probability of mortality, as it will be high for most any fire, but the ability to control the fire at a small size. By keeping fires smaller until trees reach a size of greater fire resistance more trees will survive across the project area. It should be noted that all the plantations in the Stephens and Moghadas study were treated with herbicides. The fuel loading data from this study was used to compare the fire behavior of their treatments with fuel models (Scott and Burgan, 2005) that would develop in the project area (Table 3- 4) and the probability of mortality in a 10 inch DBH ponderosa pine.

Alternative 1 would create a mosaic of fuel profiles. Untreated areas, such as snag patches, low mortality areas, and riparian corridors, would provide areas of least fire spread in the near and mid future (5 to 25 years) as they progressed toward a fuel model SH7. These would aid to limit fire spread in this time period. The treated areas would be maintained at the stage where they can be best described by fuel models GR4 and GS2. While these areas have a greater spread rate the resistance to control is conversely less (Figures 3-2 to 3-5). The GR4 and GS2 fuel models also show a greater reaction to live fuel moisture (Table 3-5). This influence of live fuel moisture indicates that these fuel types will not readily burn until the live fuel has began to enter dormancy at live fuel moistures of less than 100 percent. This means that through the majority of the year any fires will be relatively easy to control. Since Alternative 1 will treat brush while it is relatively small, any contribution to the fuel load of standing dead brush would also be small.

Further, these brush skeletons would likely fall over from breakage and/or be crushed by snow during the first or second winter.

Table 3-4. Fire Behavior for Various Treatments and Fuel Models under 90th Percentile Weather

	Treatment	Rate of Spread (chains/hr)	Fire Line Intensity (Btu/ft/s)	Flame Length (feet)	Fire Area After 1 hr. (acres)	Probability of Mortality of a 10 inch DBH Ponderosa Pine
Stephens and Moghadas 2005	Sprayed and unthinned	4.6	45	2.6	0.7	25
	Sprayed and thinned w/chainsaw	5.3	34	2.3	1.0	25
	Sprayed and thinned w/masticator	3.2	13	1.5	0.3	25
Freds Fire Fuel Models	Fuel Model GR4*	51.4	428	7.3	126	99
	Fuel Model GS2*	25.5	221	5.4	63	47
	Fuel Model SH2*	9.6	234	5.5	23	57
	Fuel Model SH7*	49.1	2,083	15.1	120	99

***GR4:** Moderately coarse continuous grass, average depth about 2 feet. Spread rate very high; flame length high.
***GS2:** Shrub cover up to 50% and is 1 to 3 feet high, moderate grass load. Spread rate high; Flame length moderate.
***SH2:** Moderate fuel load , shrubs cover at least 50% of the site, depth about 1 foot, no grass fuel present. Spread rate low; flame length low.
***SH7:** Very heavy shrub load, depth 4 to 6 feet. Spread rate high, flame length very high.

The increased ability of fire suppression under this alternative provides the greatest probability of seedling survival. While any small conifer within a likely fire will probably not survive, the ability to contain fires at a smaller size increases the probability of seedling survival across the landscape. This alternative would also provide the communities of Silver Fork and Kyburz with the greatest protection from wild fire through the increased suppression capabilities.

Table 3-5. Expected Fire Behavior in 90th Percentile Weather and 50 Percent Slope

Fuel Model 80 percent Live Fuel Moistures	Rate of Spread (chains/hr)	Fire Line Intensity (Btu/ft/sec)	Flame Length (feet)	Fire Area After 1 hr. (acres)
Fuel Model GR4	51.4	428	7.3	98.9
Fuel Model GS2	25.5	221	5.4	24.2
Fuel Model SH2	9.6	234	5.5	3.3
Fuel Model SH7	49.1	2,083	15.1	88.1
100 Percent Live Fuel Moistures				
Fuel Model GR4	11.4	30	2.2	4.9
Fuel Model GS2	14.1	85	3.5	7.4
Fuel Model SH2	6.4	124	4.1	1.5
Fuel Model SH7	40.6	1673	13.7	60.3
120 Percent Live Fuel Moistures				
Fuel Model GR4	1.2	1	0.5	0.1
Fuel Model GS2	4.3	10	1.3	0.7
Fuel Model SH2	2.2	17	1.6	0.2
Fuel Model SH7	34.7	1403	12.6	44.0

Indirect Effects

This alternative would allow a fuel complex to develop so that future treatments could be applied to the ridge tops and canyon bottom. These treatments would require less impact, as the amount of brush would be greatly reduced over that of Alternatives 2 and 3. It is highly unlikely the mid-slopes would have fuel treatments in the future because the slopes (generally greater than thirty-five percent) preclude mechanical treatments and hand treatments could be cost prohibitive. This alternative would result in a fuel complex that would make future treatment less necessary.

Cumulative Effects

Alternative 1 would, in conjunction with the expected actions to be taken by the private landowners in the project area, enable effective fire suppression action to be conducted on both private and National Forest System (NFS) lands treated. Coordinated fire suppression tactics would be easier to implement across all ownerships. The opportunity to apply prescribed fire to the upper portions of the area in the future would also be facilitated by this alternative due to the relatively low fuel loadings anticipated, the exception being the snag retention clumps. Alternative 1 serves to enhance the opportunity to achieve the overall goal in the Sierra Nevada Forest Plan Amendment to reintroduce fire and reestablish the fire regimes that maintain ecological systems and processes. Alternative 1 would serve to reduce fire suppression difficulties in the area as a whole.

Alternative 1 may also enable the future development of strategically placed landscape area treatments (SPLATs) within the project area. SPLATS are areas treated with the overall objective of reducing uncharacteristically severe wildland fire effects across the landscape. The SPLATS, in conjunction with the Roadrunner Fuels Reduction Project, Jane Doe Fuels Reduction Project, and private land treatments, would provide an opportunity to achieve these objectives.

The Freds Fire landscape in its pre-fire condition was outside the historical ranges of variability for its Fire Regime Condition Class (FRCC) because of tree density and fuel loading (ENF Forest Condition Class Layer). Following the fire this same area is still outside the historical ranges of variability in its FRCC in amounts and sizes of brush fields (LANDFIRE Rapid Refresh FRCC layer). Implementation of Alternative 1 would move the project area towards maintaining fuel loading within the historical range of variability, reducing the probability of an “intense reburn” situation into the future, given the high probability of fire starts in the American River Canyon. The “intense reburn” assumption is based on the physics of fire behavior: the greater the amount of available fuel the greater the fire line intensity and the difficulty of fire suppression (Rothermal 1983).

Alternative 2 (No Action)

Direct Effects

In the first years following the fire grasses will predominate. Now, deer brush, bear clover and other brush species are beginning to dominate the site. The fire behavior of these fuels complexes can be best described with the standard fuel models defined by Scott and Burgan (2005). The initial grass stage is defined as a moderate load, dry climate grass model (GR4). As brush begins to take over the site it is modeled as a moderate load, dry climate grass-shrub model (GS2). When brush takes over the site but is still young with little dead material in it, it is modeled as a moderate load, dry climate shrub (SH2). When the deer brush has matured and accumulated a significant dead fuel component it is modeled as a very high load, dry climate shrub (SH7). Barring disturbance, the grass and grass-shrub stages should be fairly short lived as brush will rapidly dominate the site. The moderate load shrub stage should persist for as long as twenty years. Barring any future disturbance the final shrub stage would persist until it is eventually over topped and shaded out by trees. Due to competition from brush species the survival and growth rates of planted and naturally recruited seedlings would be low (refer to Chapter 3 - Vegetation Management) resulting in a canopy closure of trees that is largely ineffective in shading out brush. Thus, the time frame for this to occur could be in the order of centuries. However, fire history shows that the area would likely experience a disturbance in the form of a large fire within the next 25 years. Given the fuel conditions in this alternative the effects of this fire would be stand replacing. These circumstances could allow the shrub stages persist indefinitely.

Table 3-6. Expected Fire Behavior in 90th Percentile Weather and 50 Percent Slope

Fuel Model	Rate of Spread (chains/hr)	Fire Line Intensity (Btu/ft/sec)	Flame Length (feet)	Fire Area After 1 hr. (acres)	Line Production Rate for a Type I crew (chains/hr)
Fuel Model GR4 (near future)	51.4	428	7.3	98.9	24
Fuel Model GS2 (early mid future)	25.5	221	5.4	24.2	24
Fuel Model SH2 (mid future)	9.6	234	5.5	3.3	6
Fuel Model SH7 (future)	49.1	2,083	15.1	88.1	6

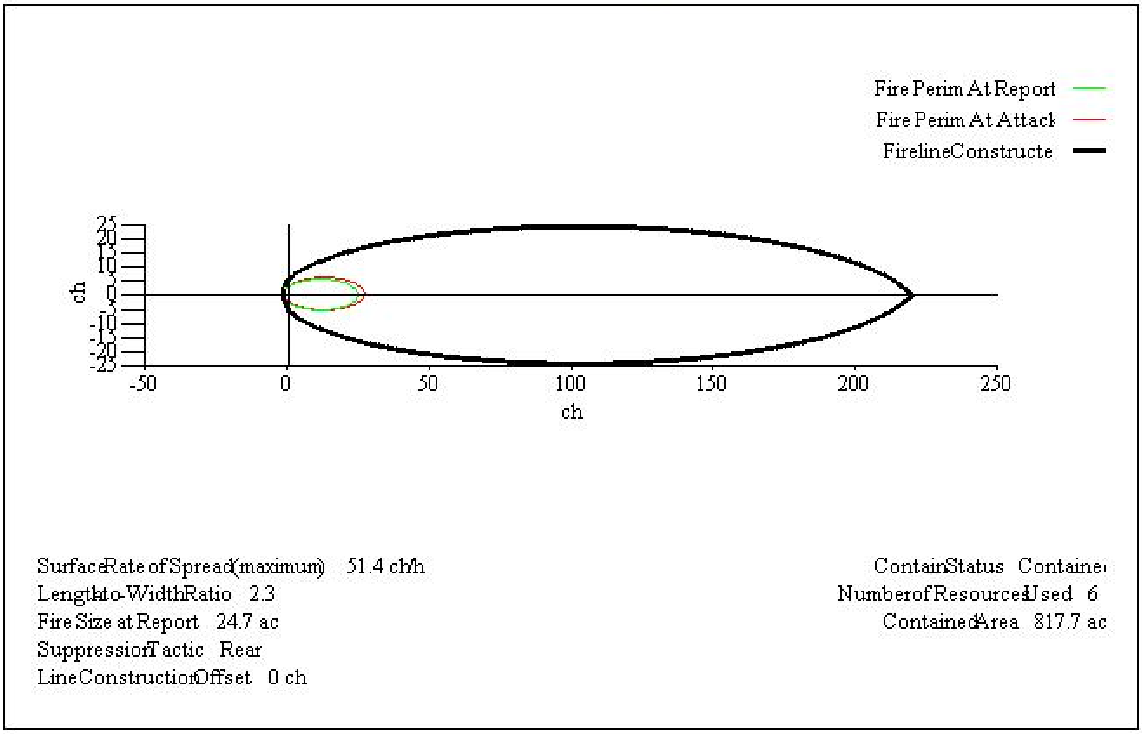
BehavePlus3 (Andrews et al 2005) was used to model the ability to contain fires in the fuel models expected to develop under the alternatives. They were modeled with the 90th percentile weather (Table 3-7) and a fifty percent slope (Table 3-6). A total of 5 engines and 1 bulldozer were used for this modeling. These resources are generally available within the area. The maximum elapsed time for this model is ten hours.

Table 3-7. 90th Percentile Weather

Dispatch Level	Moderate
1-hour fuel moisture	4 to 5 percent
10-hour fuel moisture	5 to 6 percent
100-hour fuel moisture	7 to 8 percent
1,000-hour fuel moisture	8 to 10 percent
20-foot wind speed	7.8 to 9.8 miles/hour
Live herbaceous fuel moisture	80 percent
Live woody fuel moisture	80 percent

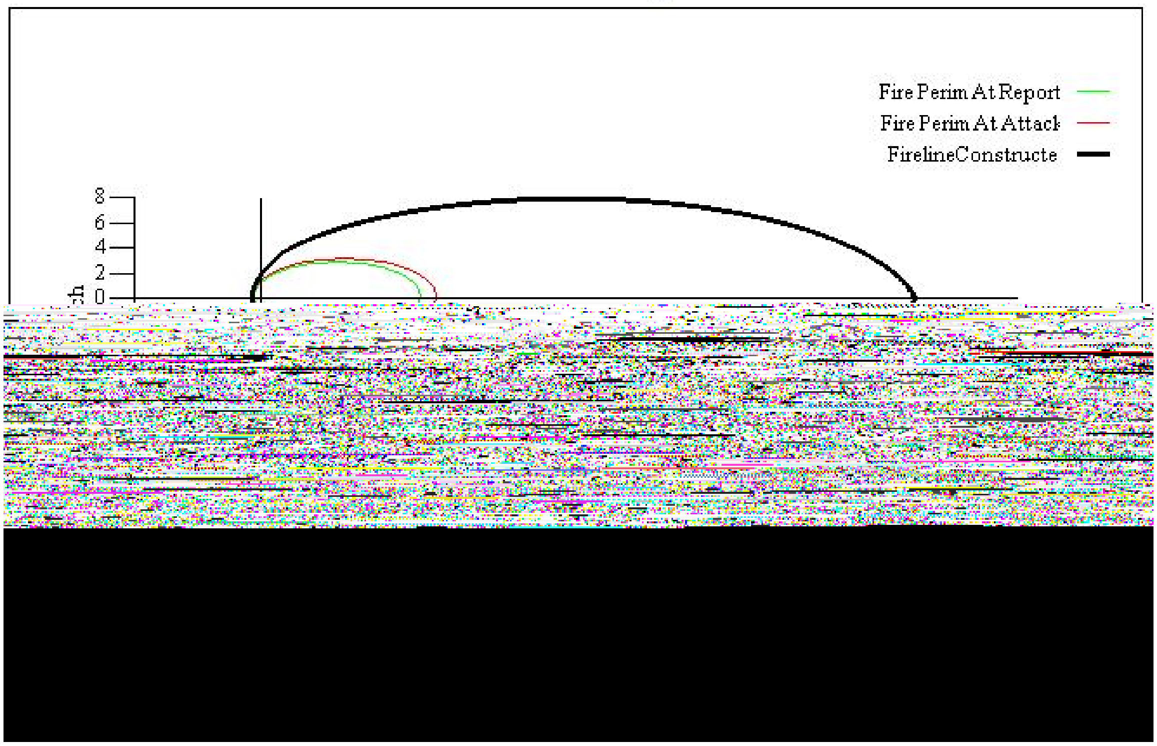
Fuel Model GR4 (Figure 3-2) – This fuel model is characterized by moderately coarse continuous grass, average depth about 2 feet. The fire spread rate is very high and the flame length is high. This model produced a relatively large fire that was contained in 3.8 hours. Line production rates in this model are the highest. The dozer can cut between eight to thirty chains per hour and the engine crews can produce twenty-five chains of wet line per hour each.

Figure 3-2. Fuel Model GR4



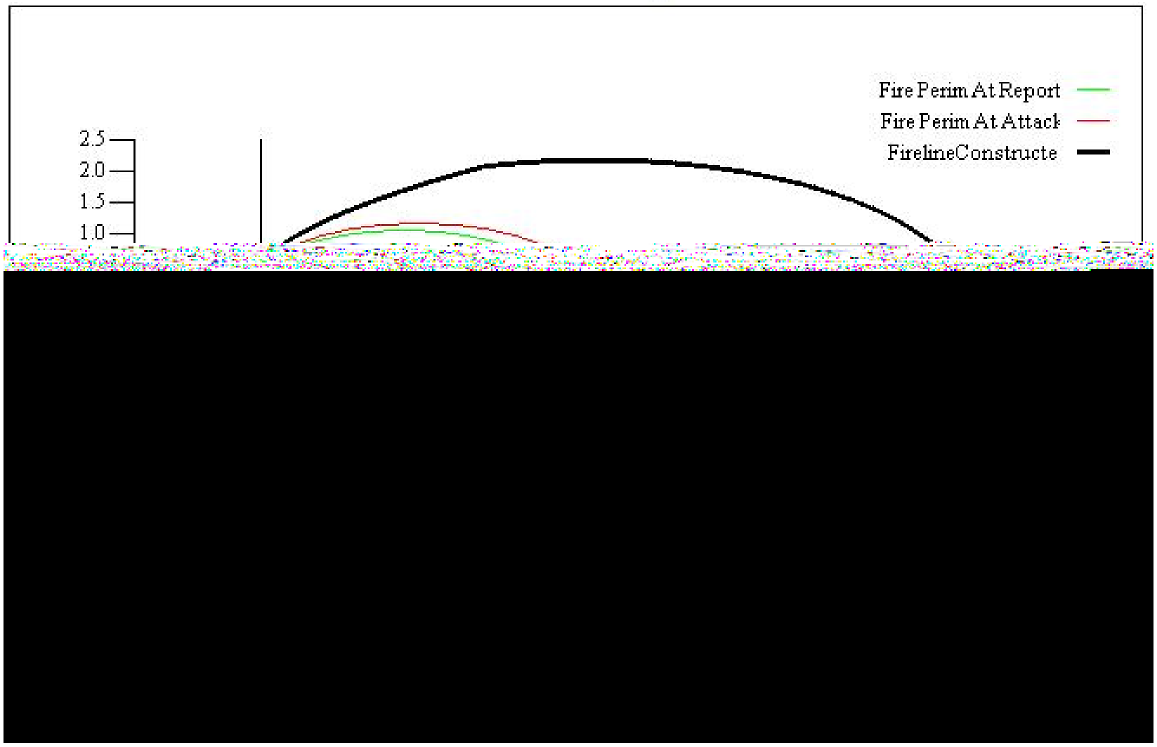
Fuel Model GS2 (Figure 3-3) – This fuel model is characterized by up to 50% shrub cover 1 to 3 feet high and a moderate grass load. The fire spread rate is high and the flame length is moderate. This model also produced a relatively large fire that was contained in 1.5 hours. The slightly smaller size can be attributed the dampening effects of the young brush. Line production rates in this model are only slightly less than those of the previous model. The dozer can cut between two to twenty-five chains per hour and the engine crews can produce twenty chains of wet line per hour each.

Figure 3-3. Fuel Model GS2



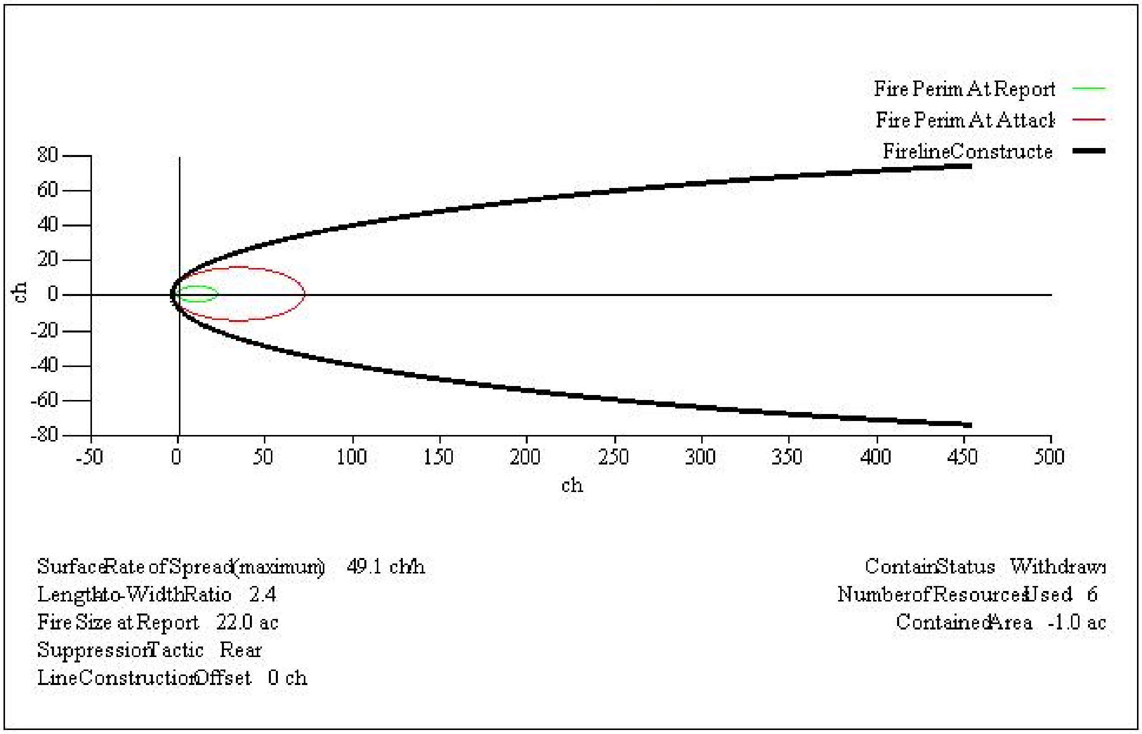
Fuel Model SH2 (Figure 3-4) – This fuel model is characterized by a moderate fuel load where shrubs cover at least 50% of the site, 1 feet deep. No grass is present. The fire spread rate is low and the flame length is low. This model produced the smallest fire which was contained in 0.7 hours. The smaller size can be attributed the dampening effects of the young brush that has fully occupied the sight. Line production rates in this model are only are similar to those of the previous model. The dozer can cut between two to twenty-five chains per hour and the engine crews can produce twenty chains of wet line per hour each.

Figure 3-4. Fuel Model SH2



Fuel Model SH7 (Figure 3-5) – This fuel model is characterized by a very heavy shrub load, 4 to 6 feet deep. The fire spread rate is high and the flame length is very high. This model produced the largest fire and the resources failed to contain it within the ten hour time period. The failure to contain this fire can be attributed its rapid spread rates (similar to the grass model) and the effect of large decadent brush to line production rates. The dozer can only cut between zero to fifteen chains per hour and the engine crews can still produce twenty chains of wet line per hour each.

Figure 3-5. Fuel Model SH7



The effects of the no action alternative would be to allow a fuel complex with rapid rates of spread, but little resistance to control (GR4, GS2), to develop over a period of 25 years into a fuel complex with rapid rates of spread and a higher resistance to control (SH7). This fuel complex would make the deployment of suppression resources on ridgetops dangerous and ineffective. It would also decrease the effectiveness of suppression resources behind the town of Kyburz, putting this community at risk.

Indirect Effects

As this fuel complex develops future mechanical treatments could be applied to the ridge tops and canyon bottom. It is highly unlikely the mid-slopes would be treated because these slopes are generally greater than thirty-five percent, precluding mechanical treatments. The cost of hand treatments on these slopes could be prohibitive. With a major interstate at the bottom of the canyon it is highly unlikely that broadcast burning would be used. Broadcast burning would put large volume of smoke on the highway threatening public safety. The mitigation for this would be to close the highway for the burning period.

Since many of these brush species are active basal sprouters, treatments utilizing hand, mechanical, and prescribed fire would only have a short-term effect.

Cumulative Effects

The no action alternative would lessen the effectiveness of the current and expected actions to be taken by the private landowners in the project area. It would negatively affect effective fire suppression action that could be conducted on both private and NFS lands treated. Coordinated fire suppression tactics would be more difficult to implement on all ownerships. The opportunity to apply prescribed fire, to the upper portions of the area, in the future would also be lessened. This alternative does not serve to enhance the opportunity to achieve the overall goal in the Sierra Nevada Forest Plan Amendment to reintroduce fire and reestablish the fire regimes that maintain ecological systems and processes. Alternative 2 would serve to increase fire suppression difficulties in the area as a whole.

This alternative will also hamper the future development of strategically placed landscape area treatments (SPLATs) within the project area.

The Freds Fire landscape in its pre-fire condition was outside the historical ranges of variability in tree density and fuel loading (ENF Forest Condition Class Layer). Under Alternative 2 this same area would be outside the historical ranges of variability in amounts and sizes of brush fields.

This would create in the canyon a large area dominated by brush, connecting the brush dominated portions in the inner gorge of the Wrights fire of 1982 and the Cleveland fire of 1992. This would leave the canyon in a condition that would support another catastrophic fire in the future. Given the probability of occurrence and the fire return interval, another stand replacing fire would be likely within 25 years.

Alternative 3

Direct, Indirect, and Cumulative Effects

This alternative has the same effects as Alternative 2 except that conifers may become established sooner over a broader area (Chapter 3 -Vegetation Management).

Hand grubbing in a four to five foot radius around seedlings would have little, if any, effect on the fuels and their development over time as changes to fuels from hand grubbing would be discontinuous and over such a small percentage of the area that these treatments do not change fire behavior substantially from Alternative 2. Thus, this alternative has the same effects as Alternative 2. Table 3-8 summarizes the effects to fire suppression for each alternative through time.

Table 3-8. Comparison of Alternatives –Fire and Fuels

Time Period	Parameters*	Alt 1 – treated acres	Alt 2, 3 and untreated acres in alternative 1
Post fire (0-5 yrs)	Fuel Model	GR4	GR4
	Flame Length (ft)	7.3	7.3
	Size after 1 hr. (ac)	99	99
	Probability of Mortality in a 10 inch DBH Ponderosa Pine	99	99
Near Future (5 -10 yrs)	Fuel Model	GS2	GS2
	Flame Length (ft)	5.4	5.4
	Size after 1 hr. (ac)	24	24
	Probability of Mortality in a 10 inch DBH Ponderosa pine	47	47
Mid Future (10-25 yrs)	Fuel Model	GS2	SH2
	Flame Length (ft)	5.4	5.5
	Size after 1 hr. (ac)	24	3.3
	Probability of Mortality in a 10 inch DBH Ponderosa pine	47	57
Future (25+yrs.)	Fuel Model	GS2	SH7
	Flame Length (ft)	5.4	15.1
	Size after 1 hr. (ac)	24	88
	Probability of Mortality in a 10 inch DBH Ponderosa pine	47	99

*Under 90th Percentile Weather and 50 Percent Slope

Vegetation Management

Affected Environment

The Freds Fire Reforestation Project consists of 46 units covering about 3,820 acres. Treatments are proposed on about 3,320 acres. No reforestation treatments are proposed on the remaining 1,000 acres within the fire perimeter. These areas include areas burned at low intensity or unharvested snag patches.

About 2,630 of the 3,820 acres in the project were classified as conifer dominated prior to the fire (ENF existing vegetation layer). These areas are located primarily in the north and west portion of the project area, in the higher elevations. Hardwoods, primarily oak, are located in the lower elevations. Prior to the fire about 125 acres were classified as hardwood, and about 1,060 acres as a hardwood/conifer mix. These areas of hardwood and hardwood/conifer mix are located mainly in the south and southeast portion of the project area. Following a fire, top-killed oaks typically basal sprout, forming clumps.

Current Vegetation Conditions

Since the fire several decision memos were implemented to begin reforesting the fire area. About 1,870 acres have been planted with conifer seedlings (2005-2009). The ground was scalped as part of the planting process and competing vegetation was removed through manual grubbing within a small radius (1.5 - 3 feet) of trees the same year.

Unit data were obtained from the stand records, fixed plot survival exams, and walk through exams in 2005 through 2008. Foliar cover of competing vegetation was based on ocular estimation taken from fixed plot or walk thru exams. Data on other vegetative characteristics, including live larger softwoods and hardwoods, and natural conifer regeneration, were also collected. Other data were obtained from district and forest records.

Vegetative cover averages about 65 percent and consists of a variety of grasses, forbs and woody brush (refer to Silvicultural Information, Appendix B). While grasses and forbs occur throughout the project area, averaging about 25 percent cover, woody brush has developed in a more distinctive pattern, reflective of the range in physical characteristics in the area, as well as different plant physiologies. Deerbrush, which resprouted from undamaged rootstock, is the major woody brush in the area of the Cleveland fire, on the western end of the fire area. Whitethorn and greenleaf manzanita, along with smaller amounts of bearclover, cherry, and gooseberry, occupy the flatter northern and eastern sections of the fire. Bearclover is the dominant woody brush species south of Granite Springs Road in the southern portion of the area. Deerbrush, whitethorn, and greenleaf manzanita occur along with bearclover.

Planted trees encounter many barriers to establishment early in their life and cannot be considered established upon planting. Currently, these conifer seedlings are exhibiting loss of vigor and mortality caused by competing vegetation. Current conifer stocking, which is the latest stocking available, regardless of year, ranges from 8 to 278 trees per acre (TPA), with an average of 98 TPA. Measured by seedling age first year survival is about 143 TPA, and third year survival is 40 percent, or about 92 TPA (Figure 1-1). Both of these measures show a steep decline in conifer stocking from initial planting levels. Current conifer stocking percent, based on the latest data, is about 61 percent. Based on the latest exams, 55 percent of the planted acres are stocked at a level below 100 TPA, and mortality is continuing.

Annual height growth, measured on several representative units, ranges from about 0.3 feet to 0.5 feet per year, while total tree height averages about 0.75 feet on one year old trees and about 1.7 feet for three year old trees (Figure 1-3). Natural regeneration of conifers is highly variable and sparse overall, averaging about 14 trees per acre.

Mortality from pocket gophers is low, and gopher activity is generally low, although small pockets of heavy gopher activity are present in the area.

As described in Chapter 1, the Forest Service in Region 5 has extensive experience, a large body of research and numerous long-term studies (ranging from 10-31 years) that clearly establish the efficacy of herbicide release to improve conifer survival, growth and development. Based on research findings and local conditions on the ENF, in 1991, a methodology (Release Evaluation Form, Appendix B) was developed on the ENF by a group of certified silviculturists and culturists to evaluate plantations as to the need for herbicides as a release tool and to prioritize the need for release. A key component of the Release Evaluation Form is to identify vegetative situations where the use of herbicides is considered essential to meeting the objective of successful reforestation. A Release Evaluation Form for each stand was completed. Each unit was assigned to one or more situations on the Release Evaluation Form (Table 3-9). If a unit currently met the criteria for a situation this was noted. If a unit did not currently meet the criteria for a situation, but was predicted to meet a situation in the near future, based on current vegetation and predicted growth, the situation and the predicted date of meeting it was noted. Each unit was then assigned a priority for treatment, based on the situation and other criteria, such as surviving trees per acre and the presence of pocket gophers.

Most of the units contain elements of many of the release need situations, either scattered over an entire unit or as inclusions within a unit. Units were classified in primary release need situation that occurred over the majority of the unit. These other release need situations were also noted.

Table 3-9. Units By Primary Release Need Situation and Priority

Situation	Total Acres	Priority 1 Acres	Priority 2 Acres	Priority 3 Acres	Units
#1 Bearclover/grass	1,518	627	853	37	609-27, 30, 33, 44; 613-51
#2 Lupine, grass, forbs, thistle, or fern with gophers	0	0	0	0	
#3 Chinquapin and/or manzanita	137		2	135	503-27; 609-34, 42, 43
#4 Low Conifer Stocking with Competition	684	684			503-8; 609-10; 613-5, 6, 22, 25, 26, 38, 47, 50, 52, 53
#5 High Volume of Woody Brush	658		250	408	503-111; 609-25, 29, 36, 37, 38, 39, 40, 41, 46; 613-42, 54
#6 High Levels of Herbaceous Vegetation	321	315	6		503-9; 609-26; 613-7, 10, 35, 37
#8 Mechanical Treatment Feasible	0				

The Pacific Southwest Region of the Forest Service has developed specific stocking standards for successful reforestation ((USDA, FS, R-5 FSH 2409.26b 1991). These standards describe the specified minimum and recommended numbers of trees per acre needed to establish a growing forest. For the mixed conifer forest type, the minimum and recommended stocking is 150 and 200 trees per acre, respectively. These standards reflect the knowledge that not every seedling has the genetic potential to thrive on the micro-site they were planted in. It also requires that the seedlings be well-distributed and growing under conditions that will allow them to "persist into the future".

A certified silviculturist can approve lower stocking levels than the Regional recommendations, if the change meets the test that the levels will "persist into the future" (FSH 2409.26b, Sec. 4.11a). The conclusion of the Freds Fire project silviculturist was that stocking standards could be set at a minimum of 100 trees per acre and "persist into the future".

The primary risk of a lower stocking standard involves establishing sufficient trees to meet the minimum standard, accounting for seedling mortality due to competing vegetation, animals, insects, disease, and drought, and to allow for the natural processes of selection of the best-adapted trees to that site. This means early stand management activities are critical to meet objectives for survival and growth to ensure there are sufficient seedlings across the landscape to meet the minimum standard into the future.

The silvicultural prescription for each unit is located in the project file. Reforestation would take an estimated eight years under Alternatives 1 and 3. Deviations from the proposed schedule could occur due to the changes in funding, contractor availability, nursery stock availability, and unpredicted weather conditions that disrupt the treatment windows for mechanical and chemical treatments. In general, variations in timing result in longer time periods and breaking up large areas into smaller ones.

Environmental Consequences

Direct, indirect and cumulative effects for conifers, hardwoods and competing vegetation consider the impacts of the alternatives when combined with the following past, present, and foreseeable future actions and events: Vegetative changes resulting from the fire and effect of future management actions. The actions contributing to cumulative effects were selected because they have caused or have the potential to cause changes in seedling survival and growth, species present, and stocking levels. The geographic scope of the cumulative effects analysis was selected because impacts to these factors are limited to a given location on the ground, irrespective of actions in surrounding areas. The temporal scope was selected because the impacts to seedling survival and growth, stocking and species at a given location can accumulate over time from different activities or events.

Alternative 1 (Proposed Action)

Direct Effects

There will be no effects to vegetation in areas where activities are not proposed. These areas are primarily unharvested snag patches and areas that burned at low intensity during the Freds fire and cover about 1,000 acres.

Vegetative competition: Initial site preparation/release treatments would use glyphosate. Competing vegetation in areas treated would experience a dramatic reduction in percent cover, to below 20% cover. Since glyphosate is a contact herbicide that has no pre-emergent effect, competing vegetation would begin to re-establish the year following treatment. Over time, the woody brush component would gradually re-establish itself, and grow. The plants would develop from seed in the soil and/or recovery of plants surviving initial treatments.

Follow-up treatment would occur, if needed, in 1 to 3 years, based on monitoring. Follow-up glyphosate treatments (3,125 acres) would again reduce competing vegetation levels below 20%, meeting the project objective. Triclopyr follow-up treatments in two units (97 acres) would reduce competing vegetation levels below 20% and would be most effective on woody brush. Triclopyr would have little effect on grasses. After an initial glyphosate treatment, competing vegetation within four units (99 acres) would be treated with hexazinone and would experience a reduction in percent cover, to below 20% cover. Hexazinone, because it is a pre-emergent herbicide, would keep grass and forb levels below 20% cover for a period of 2-3 years. The effects on sprouting woody brush would be more sporadic.

This alternative would meet the short-term silvicultural goal to keep competing vegetation levels below twenty percent (total live ground cover) for a period of two to three years after planting.

Direct effects to culturally important plants that exist within treatment units could occur through death of plants or through non-lethal exposure to herbicides which may render them unusable or unacceptable by gatherers. Herbicide treatments could result in plants being dead, dying, chlorotic, brittle or deformed and, hence, undesirable to consume in the long-term. Throughout treatment units some plants would survive herbicide treatment by either being located in excluded areas (untreated buffer strips, sensitive plant areas) or through skips during application, receiving a less than lethal dose, or not being targeted during application. Individual plants killed during herbicide treatments would be eliminated from the site and not available to gatherers. Signs, posted at likely access points for each treatment unit, would alert the public of the specific herbicide and date the unit was treated and would reduce potential for exposure to herbicides. As previously described, there will be no direct effects, including culturally important plants, on about 1,000 acres where no herbicide treatments are proposed.

Hardwoods: Direct effects to hardwoods would be minor, as they would be protected during reforestation activities. Where oak densities, including resprouting oaks, preclude planting of conifers (conifers would not be planted within 20 feet of the crown dripline of mature live, or sprouting, hardwoods), these stands would develop as oak stands. This would cover an estimated 125 acres. Where more scattered, planting of conifer would result in mixed conifer/oak stands. This would cover an estimated 1,060 acres. Scattered oaks would also be present in some conifer dominated stands.

Oaks would not be intentionally sprayed, including seedlings, sprouts, and larger trees, during herbicide treatments and would remain a part of the stand's species composition. Application with hexazinone can severely damage or kill oaks and it is possible some oaks may die as a result of hexazinone application. There are very few oaks within areas proposed for hexazinone treatment. Results of monitoring of two stands in the Cleveland Fire area treated with hexazinone in a manner similar to this proposal, showed that oaks can, and do, survive hexazinone treatment. In these stands, results showed 3.0 and 3.9 oak clumps per acre, based on a 100 percent survey. Only one dead oak clump was found in the entire survey area of 39 acres. The cause of death is unknown (USDA, 2004a). Thus, the majority of oaks will survive, be promoted, and become part of the stand, adding to stand stocking levels.

Conifer survival/species composition: By meeting competing vegetation levels objectives, and by interplanting, conifer survival levels would be sufficient to meet minimal stocking requirement of 100 established seedlings per acre by age five to ten years. While some additional mortality may occur, it is expected that the prescribed treatments would maintain survival near this level. Interplanting or replanting would be possible and would be prescribed, based survival and stocking criteria (Chapter 2), from on future exams and to meet project objectives, including evaluating opportunities to provide patches (<1 acre) of early seral vegetation. Currently, about 665 acres would be replanted or interplanted. By providing for patches of early seral vegetation, 80 to 90 percent of planted acres (2,650- 3,000 acres) would meet the minimal stocking requirement of 100 seedlings per acre and be certified as adequately stocked by age ten or sooner.

Effective vegetation control is particularly critical for the establishment of non ponderosa/Jeffrey pine conifers, such as red fir, white fir, Douglas fir, sugar pine, and incense cedar. These species typically have much lower early survival success than ponderosa/Jeffrey pine. Treatments under this alternative would be reflected in greater survival percentages of all of the mixed conifers species in the project area, resulting in the establishment of a mixed conifer forest.

Sugar pine and incense cedar are susceptible to hexazinone. Application in the rooting zone may cause mortality of some trees. Design features under this alternative (large no herbicide buffers in streamcourses and not applying hexazinone within the dripline of sugar pine or incense cedar greater than 5 inches diameter) would greatly reduce mortality to sugar pine and incense cedar on the 99 acres of the project where it is proposed.

Aquatic features: Within the buffered areas adjacent aquatic features throughout the project area, varying widths of herbicide release/hand release/no release zones are proposed. The effects on conifer survival and growth in hand released areas would be similar to Alternative 3, although the availability of water to conifers proximate to these streams may increase conifer survival. Where no release is proposed, the effects on conifers would be similar to the no action alternative. These areas would develop into zones of dense woody vegetation with slower growing conifers.

There would be little to no effect to riparian species, as these species would be protected by no herbicide spray buffer strips . Sprouting plants, such as alders, dogwoods, maples, or willows, would be the dominate species in riparian areas. These species primarily grow adjacent to streams, springs, seeps, or other areas with water. The scattered individuals of these species that may be growing beyond these buffer strips could be killed, but this would constitute few individuals. Riparian species within hand release zones could be cut, but there would be little mortality as they would resprout and grow.

Growth: Results of a long-term study, measurements in the local area, and two modeling programs (SYSTUM-1 and Forest Vegetation Simulator) were used to estimate future growth in the project area.

As previously stated, the Forest Service in Region 5 has extensive experience, a large body of research and numerous long-term studies (ranging from 10-31 years) that clearly establish the efficacy of herbicide release to improve conifer survival, and accelerate growth and development. Increased growth would accelerate the development of key habitat and old forest characteristics and reduce the risk of loss to wildland fire (SNFPA ROD, page 49).

In a study near Mt. Shasta (McDonald and Abbott 1997), foliar cover of grasses corresponded well to the trend in shrub density. The paper looked at four different shrub density regimes- no, light, medium, and heavy shrubs. The Mt. Shasta study measured the growth of planted trees during the 31 year study and found statistically different height and diameter values for each of the four shrub density regimes. The no shrub or light shrub categories in the study most closely resembles what Alternative 1 would be in terms of competing vegetation. The average tree height after 31 years in the no shrub category was almost 3.4 times that of the “heavy shrub” average tree height, while the average tree height in the light shrub category was about 2 ½ times that of the “heavy shrub” average tree height. Similarly, the no shrub average tree diameter was almost 3.7 times that of the “heavy shrub” environment, and the light shrub average tree diameter was about 2.8 times that of the “heavy shrub” environment (Table 3-10). The study concluded that after 31 years, the differences in tree height were still widening.

Table 3-10. Diameter and Height of 31 Year-old Trees

Shrub Density	None	Light	Medium	Heavy
DBH (inches)	7.85	6.11	4.56	2.14
Height (feet)	30.4	21.6	15.2	9.0

*From Table 9 (McDonald/Abbott: PSW Research Paper 231, 1997)

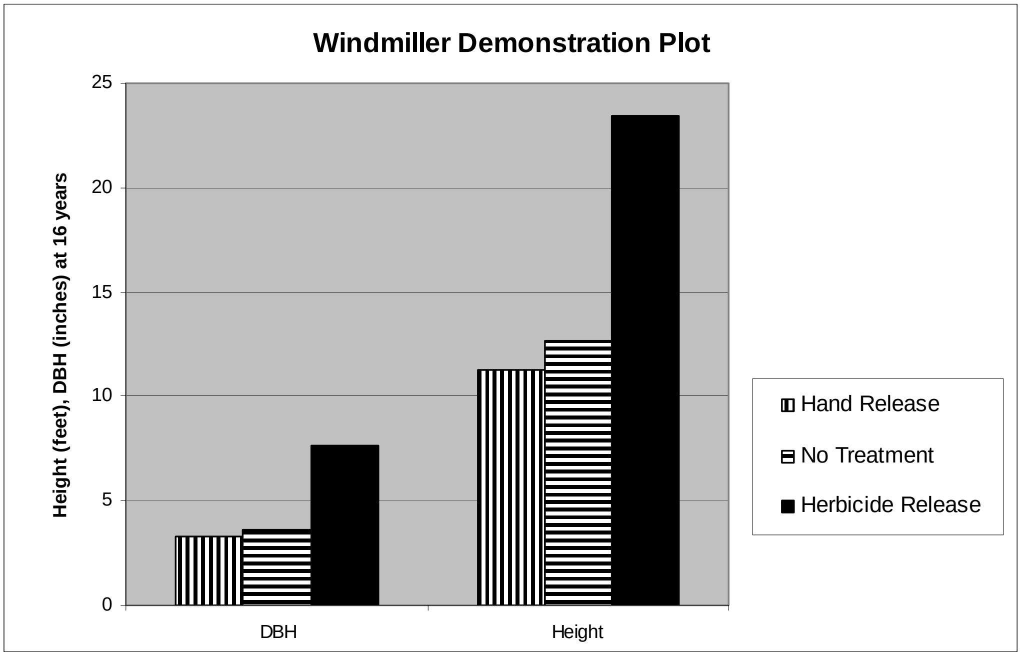
Powers et al (2004), on a site near Georgetown, found the influence of shrubs on growth lasted much longer on poorer sites than on more productive sites. By age 37, 28 years after treatments, growth rates on a poorer Mariposa soil increased following brush removal and continued to separate from the control. By contrast, on a more productive Cohasset soil, differences were less striking and plateaued about a decade after release. Following that, growth patterns for treated and untreated plots were essentially parallel. However, even in treated plots on better sites, stands remain at high risk to ground fire as a persistent fuel ladder connected the ground to the canopy.

Local results

Height and diameter were measured locally on trees planted and herbicide released after the Cleveland Fire. On a good site off of the Raincoat Road, ponderosa pine averaged about 34 feet in height (range 26-44) and 9.6 inches DBH (range 6.6-12.1) at 16 years old. Other vegetation on the site consisted of grasses, forbs, and small brush (deerbrush and manzanita) forming close to 100 % ground cover. On good sites in the Freds Fire similar diameter and height growth could be expected.

Trees were measured on a 16-year old local field demonstration plot in the Cleveland Fire near the Freds Fire. This site was of lower site quality than the Raincoat site. Trees in the demonstration plot, representing herbicide, hand release, and control plots, were measured. Both herbicide and hand release plots received two release treatments. Results for Jeffrey pine trees are shown in Figures 3-6. Heights and DBH averages for all species combined showed similar results. The hand release plot totaled 44 trees per acre; the control plot totaled 56 trees per acre. The trees in the herbicide plot had been precommercially thinned. As on the Raincoat road site, grasses, forbs and small brush occupied the herbicide treated plots, while brush 5-6 feet tall (whitethorn, greenleaf manzanita) dominated the hand release and control plots (Figures 3-7 and 3-8).

Figure 3-6. Tree Height and Diameter from Two Treatments and No Treatment



SYSTUM-1 small tree growth simulator (Richie and Powers 1993) was used to predict future growth and development of trees, forest attributes, and competing vegetation in the project area to age 50. SYSTUM-1 is more applicable to this area, meaning that the data collected and vegetation types coincide better with the vegetation types in the Freds Fire, than a newer model (Conifers) whose applicability is primarily in the North coast of California and into Oregon (Richie, M. personal communication, 2008). SYSTUM-1 was originally intended for stands between the ages of 3 and 20, although there are no specific age constraints in the simulator.

Projections beyond age 50 were made using the Forest Vegetation Simulator (FVS) to estimate the age where average stand diameters reached 12 and 24 inches, and the age where canopy closure reached 40 and 60 percent. Input was taken from the 50 year averages for diameter and height from Table 3-11. Site Index was set at Forest Survey Site Class 3, an average site for the project area. Growth was not suppressed for any alternative, assuming the growth suppression effects of shrubs will have ceased. If suppression effects from shrubs do continue beyond 50 years, using default values in the projection would result in an overestimation of growth in Alternative 2 and 3 for a number of years, until growth suppression ceased.

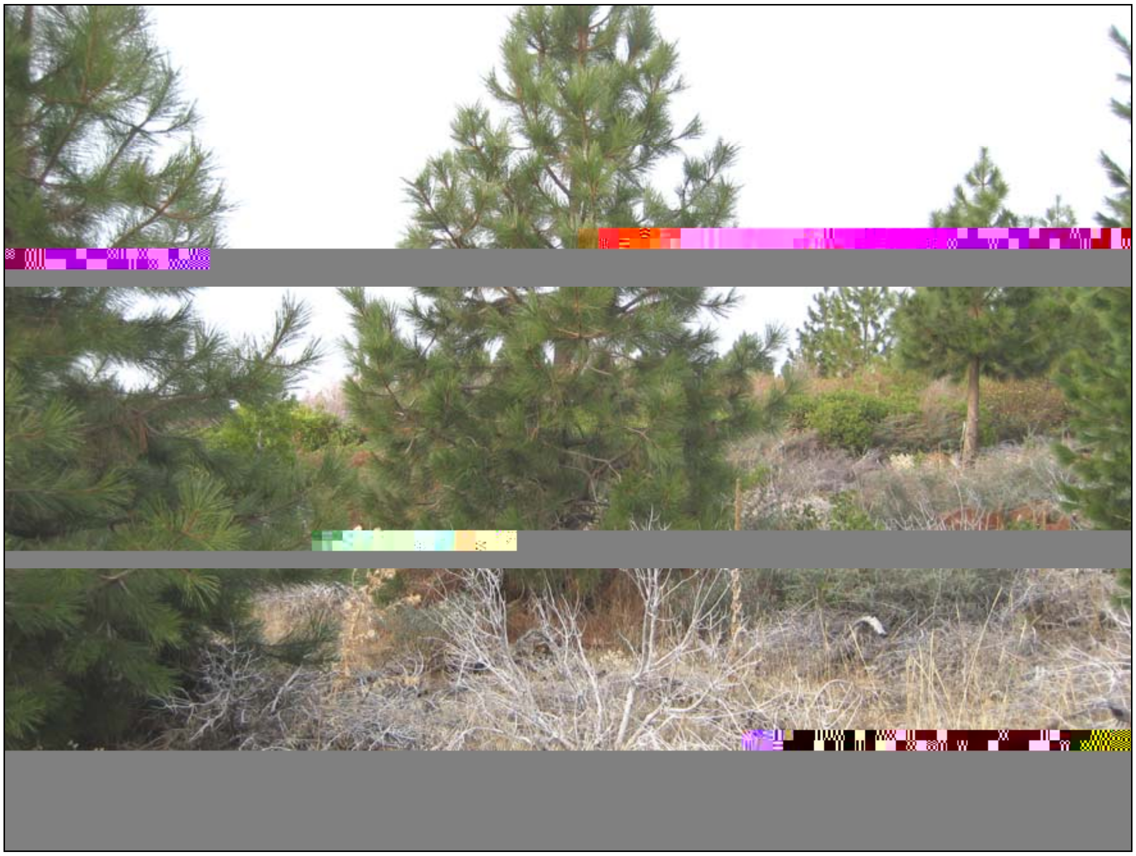
A summary of the above information is displayed in Table 3-11, below. The averages for 15 and 50 years coincide closely with the Windmiller site and the SYSTUM-1 model. The Raincoat Road Site and the Mt Shasta Study results display the range of what could be expected on higher and lower sites.

Table 3-11. Projected Diameter and Height of Conifers at 15 and 50 Years (Alternative 1)

Range of Data	15 years		50 years		Age for
	DBH	Height	DBH	Height	24 inch trees
Raincoat Road Site	9.0	31.6	30.0	105	
Windmiller	6.2	19.8	20.6	66	
SYSTUM-1	6	21.4	17.2	76	
Mt. Shasta	4.2	14.7	12.7	49	107
FVS					80
Average	6.4	21.9	20.1	74	

Figure 3-7. Windmiller Demonstration Plot (Hand Release Plot at 16 Years)

Figure 3-8. Windmiller Demonstration Plot (Herbicide Release Plot at 16 Years)



By 15 years (Table 3-11) conifers would average about 22 feet in height (range 15 to 32) and have a diameter breast height (DBH) of about 7 inches (range 4-9). These estimates coincide well with planted conifers established under the Cleveland Fire Area Vegetation Management Program for Conifer Plantation Establishment Environmental Assessment (USDA 1994a) that survived the Freds Fire, which are currently about 12-20 feet tall, and have a DBH of about 5-7 inches (13 years after planting). Average oak height would be somewhat taller than conifers because they sprouted from established root systems, although on good sites conifers are likely to be as tall as oaks. Their average diameter would be smaller than conifers due to the large stem numbers in a clump. By age 50 conifers would average about 74 feet in height (range 49 to 105) and have a diameter breast height (DBH) of about 20 inches (range 13 to 30).

Fuel Reduction Treatments: Masticating shrubs within ¼ mile of Highway 50 (about 388 acres) would have little to no effect on tree growth as most of these shrubs would resprout and recover, using water and nutrients as prior to the treatment. Mechanical damage by the masticating machine or flying debris could cause damage or mortality to trees, but is expected to be minor. Heavily damaged trees could be removed.

Indirect Effects

Over the short-term, plant abundance may be affected by herbicide treatments, but no plant species would be eliminated from treatments units. Plants that survive herbicide treatment would recover and grow. Plants outside the treatment units would serve as seed sources for recruiting into treatment units. The existing seed banks within treatment units would also be sources for recruitment within the units. Contact herbicides (glyphosate and triclopyr) would not affect seeds in the ground, which could germinate and grow following application. Clopyralid, a contact herbicide with a short residual effect on seeds, would prevent germination of seed for the growing season. It is selective and its effects would only be seen on several members of the sunflower family (*Asteraceae)*, legume family (*Fabaceae*), nightshade family (*Solanaceae*), and some species in the knotweed and carrot families. Hexazinone would affect seed germination, with decreasing effectiveness, for two to three seasons after application.

In mixed forests in Canada, Sutton (1993) found no detectable effect on species composition ten years after herbicide treatments. DiTomaso et al. (1997) in northern California found no long-term detrimental effect on vegetative cover or species evenness with herbicide use. They also found that, in areas without herbicide treatment, biodiversity and to a lesser extent species evenness had not recovered after 14 years, in contrast with herbicide treated areas.

Over the longer-term, culturally important plants that favor early seral, open conditions would be enhanced, as activities under this alternative would maintain units in this condition for a longer period of time as compared to the other two alternatives.

Species and structural diversity within stands would be conserved as heritage resource, sensitive plant areas, areas that burned with low intensity in the Freds Fire, and snag patches left untreated in the Freds Fire Restoration EIS would not be reforested or released. Areas with a high concentration of surviving or sprouting oaks would maintain a large abundance of oaks. Natural variations such as surviving conifers, rock outcrops, and riparian areas contribute to diversity, as would small patches of early seral vegetation within units. In addition, there would be no herbicide treatment zones for varying widths adjacent aquatic features. Species in the outer part

[1] Assuming same rates of growth as last 13 years of PSW Research Paper 231 study
[2] The site conditions in the McDonald study are slightly lower than those represented in the Freds Fire and therefore the values were adjusted to reflect those differences

Table 3-12b. Estimated Age to meet Stand Parameters - FVS

	Alt 1	Alt 2 (planted)	Alt 3 (planted)
>12 inches (CWHR4)	< 50	57	54
>24 inches (CWHR5)	80	112	115
>40 Percent CC (CWHR M)	<50	150	110
>60 percent CC (CWHR D)	60	>150	>150

Risk of loss to wildland fire: Small trees by nature are susceptible to low intensity fires. Most of the 7-8 year old trees in the St. Pauli fire were killed. The few trees that are still alive probably survived from a combination of light vegetation and topography (gentler slopes, ridges). As trees increase in height and diameter the probability of fire-induced mortality declines. Under this alternative diameter and height growth would be the fastest, with trees reaching a DBH of 10 inches in an estimated 20-27 years (refer to Tables 3-3a,b,c).

Cumulative Effects

This alternative would contribute about 3,320 acres with sufficient oak and mixed conifer stocking and growth to allow eventual attainment of the desired future conditions as defined by the SNFPA ROD (p 49). The project area landscape is a combination of private timberlands and public lands. The private timberlands are managed for timber production and therefore will likely develop these levels in less than 80-90 years. There are no effects on the development of forest structure on ENF lands as a result of private land activities.

The loss of individual culturally important plants or their undesirability for gathering and use on about 3,320 acres proposed for herbicide treatment on this project could result in short-term cumulative effects. These effects would be temporary, lasting until herbicide residues were eliminated from plants (potentially up to 2 ½ years for hexazinone) and surviving plants recover or seed in from surrounding areas or untreated portions of treatment units.

Alternative 2 (No Action)

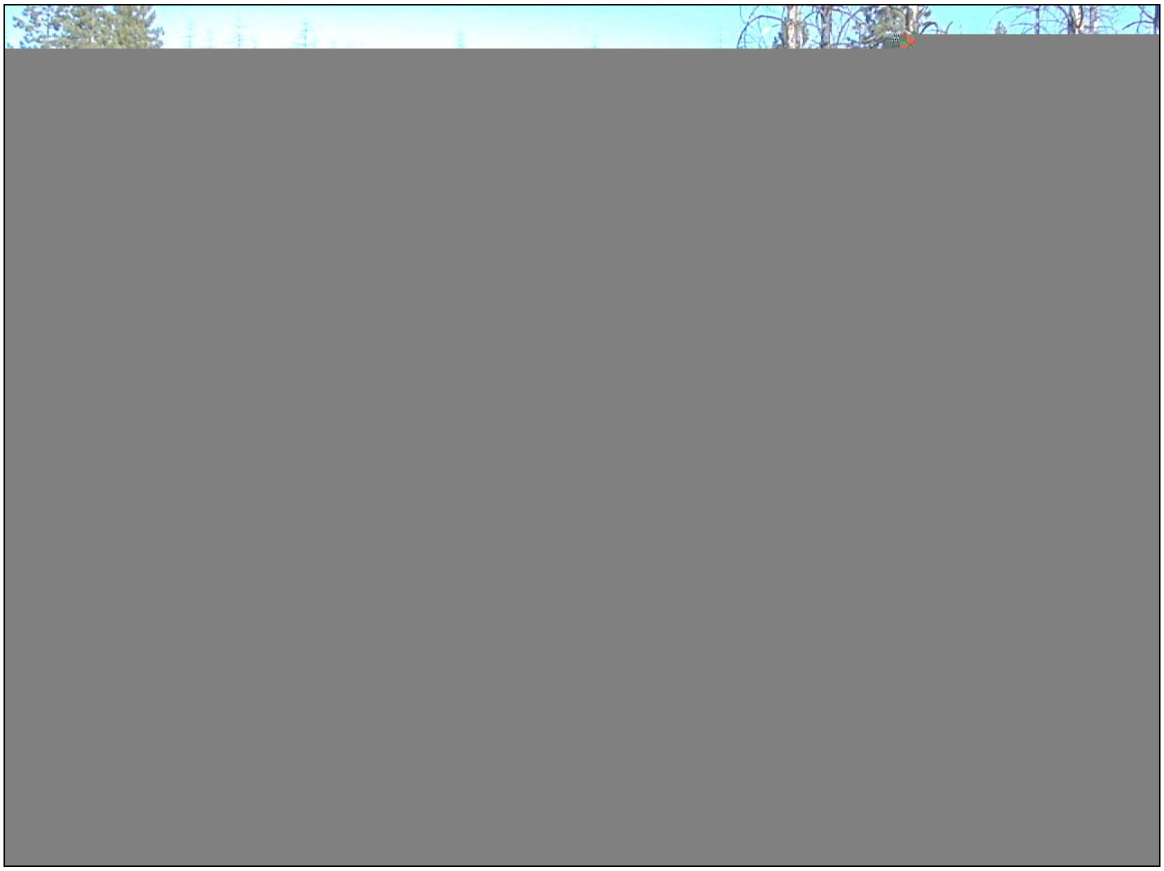
Direct Effects

There would be no direct effects from this alternative since no activities would take place. No release or invasive plant treatments would take place. This alternative would have no direct effects on culturally important plants from herbicides as plants would not be exposed to herbicides.

Indirect Effects

Vegetative competition: In the absence of any further activities, the area would continue to be occupied by competing vegetation, and densities would quickly approach 100 percent cover (Figures 3-9). Woody brush, would begin to dominate, overtopping conifer seedlings. A continuous horizontal woody brush layer would develop in units, limited only by environmental factors. The woody brush layer would also expand vertically up to its potential, resulting in brush heights of two feet (bearclover) to 10 feet and higher (deerbrush, cherry). This alternative would not meet the short-term silvicultural goal to keep competing vegetation levels below twenty percent (total live ground cover) for a period of two to three years after planting.

Figure 3-9. Deerbrush in Untreated Area of the Cleveland Fire at Five Years



Hardwoods: Oaks, which were top-killed in the Freds fire, have resprouted from rootstock and exist in clumps. Established rootstocks have provided resources which allowed stems to grow in height quickly. Oak clumps would continue to grow in full sun and become locally dominant over competing vegetation. This dominance will continue into the future, and oaks will survive, and become part of the stand overstory. Stands classified as oak in ENF Forest vegetation layer would develop into stands of oak woodland. This is estimated to cover about 125 acres in the project area. Stands classified as mixed conifer/oak would develop into low density stands of oak. Any conifer component of these stands would slowly develop from scattered natural regeneration. This would cover an estimated 1,060 acres.

Conifer survival/species composition: Planted trees, currently averaging about 100 trees per acre (TPA) after 1 to 4 years, would continue to die from moisture stress from competing vegetation on these harsh, south facing slopes. Conifer survival rates would continue to decline, and the resultant stand would contain fewer trees and a sparser canopy cover than the proposed action or alternative three. Competing vegetation would be able to survive and grow under this relatively sparse canopy cover. Overall, low conifer survival would result in large areas of plantation failure. Acres that are currently stocked below 100 TPA would not meet minimal stocking requirement of 100 TPA. Most of the other plantations, currently stocked at over 100 TPA, would suffer enough conifer mortality to fall below the minimum stocking standard of 100 TPA, leaving an estimated 350-600 acres (25-40 percent of the acres currently over 100 TPA and 125 acres of oak) meeting the minimal stocking requirement of 100 seedlings per acre and be certified as adequately stocked by age ten or sooner.

Natural regeneration would be the source of conifer stocking in areas where trees have not been planted. Some conifers have seeded in (average 14 TPA) and would continue to seed in from scattered mature trees that survived the Freds fire. Seed germinating from these sources into the future would encounter greater competition for moisture than current conditions as the temporary reduction in competing vegetation as a result of the fire have dissipated. Conifer survival would be low due to moisture competition and a vegetative overstory of grasses and shrubs, resulting in a sparse conifer component within a 100 percent cover of shrubs. Shade tolerant conifer species (incense cedar, Douglas fir, and white fir) would be more likely to eventually be established under a brush understory, however overall tree cover would be low due to a lack of nearby seed sources and vigorous competition. The eventual species composition in these areas, as a result, would have low percentages of shade intolerant conifers (such as ponderosa and Jeffrey pine and sugar pine).

Growth: Early stand development (50 years and less) would be considerably slower, and less dense, than the proposed action. Estimates of growth for this alternative were determined using data from FVS, SYSTUM -1, Windmiller demonstration plot, and the Mt. Shasta Study and are displayed in Table 3-13. These projections assume wildfire can be excluded in the vegetation that develops under this alternative, which is an unlikely scenario (refer to Chapter 3- Fire and Fuels). A stand replacing wildfire within the project area could "reset" the vegetative conditions back to early seral conditions, dominated by shrubs.

Table 3-13. Projected Diameter and Height of Conifers at 15 and 50 years (Alternative 2)

Range of Data	15 years old		50 years old		Age for
	DBH	Height	DBH	Height	24 inch trees
Windmiller	3.1	11.1	10.3	35	
SYSTUM-1	3.9	14.5	14.4	55	
Mt. Shasta	1.1	4.4	3.5	14.5	391
FVS					112
Average	2.7	10	9.4	35	

At 15 years conifers would average about 10 feet in height (range 4 to 15) and have a diameter breast height (DBH) of about 3 inches (range 1 to 4). Average oak height would be taller than conifers, result of early growth from sprouting from established root systems. Their average diameter would about the same as the conifers due to the large stem numbers in a clump. By 50 years conifers would average about 35 feet in height (range 15 to 55) and have a diameter breast height (DBH) of about 9 inches (range 4 to 14).

Areas with a high concentration of surviving or sprouting oaks would maintain a large abundance of oaks. This alternative would not maintain the early seral open conditions that some plants favor for as long a time period, as compared to the proposed action alternative. Those plants would likely become less abundant under this alternative, existing primarily in naturally occurring open areas such as low sites, and rock outcrops.

There is considerable variability in projections of diameter beyond 50 years because of the assumptions used. Projections from the Mt.Shasta study assume growth rates would continue as in the final 13 years of the study, where growth suppression effects of competing vegetation are still widening. The FVS projections use the default growth rates, which assume effects of growth suppression beyond 50 years are no longer evident. Thus, these projections frame the range of growth beyond fifty years.

The trees in the Mt. Shasta study in the “heavy shrub” categories in the study most closely resembles what Alternative 2 would be in terms of competing vegetation. The trees in this study would take approximately 390 years to develop into large trees ($\geq$ 24 inches DBH) assuming a consistent rate of growth beyond the life of the study. It is estimated that the trees under Alternative 2 would take 200-250 years to develop into large trees due to higher site conditions in the project area (Table 3-12a).

Based on FVS projections, large trees would develop in about 110-115 years A 40 percent canopy closure in already planted areas would be achieved in about 150 years. A 60 percent canopy level would be unlikely from the planted trees, due to the sparse tree cover (Table 3-12b).

Where trees have already been planted, the treatments proposed under this alternative will result in a landscape of 30-40 trees per acre with average diameters of 24 inches and canopy closure of 40 percent in about 150 years (range 150-250). Unplanted areas would depend on natural regeneration and would take longer than planted areas to develop because of a longer time for trees to become established and their slower growth while under a brush overstory. Here, the landscape would consist of scattered trees with a sparse canopy. Under this sparse tree canopy, vegetation would persist, with little shading out of vegetation expected. Oak stands would develop as in all the alternatives.

Over the short-term, plant abundance would be unaffected. Over the longer-term, culturally important plants that favor early seral, open conditions could be negatively affected by the continuous horizontal woody brush layer that develops under this alternative.

Risk of loss to wildland fire: Small trees are susceptible to mortality from low intensity fires. This alternative would result in the shortest, smallest diameter trees of any alternative, with trees reaching a DBH of 10 inches in an estimated 35-40 years.

Cumulative Effects

The project area landscape is a combination of private timberlands and public lands. The private timberlands are managed for timber production and therefore will likely develop a mature forest in less than 80-90 years. There are no effects on year following treatment, from seed. Such vegetation would include grasses, forbs, whitethorn, and *Ribes spp.* (Click et al 1988).

Through repeated follow-up treatments, competing vegetation levels, although exceeding the 20 percent objective in the unit as a whole, would meet the objective within the critical radius around the tree, at least through this decade.

Direct effects to culturally important plants that exist within treatment units could occur to plants located within the hand release radius around seedlings. Some severed plants would resprout. Outside of the hand release circles in treatment units, and in areas of no planting there would be no direct effect on culturally important plants.

Hardwoods: Direct effects on hardwoods would be minor, as they would be protected during reforestation. Where oak densities, including resprouting oaks, preclude planting of conifers (conifers would not be planted within 20 feet of the crown dripline of mature live, or sprouting, hardwoods), these stands would develop as oak stands. Where oak is more scattered planting of conifers would result in mixed conifer/oak stands.

Conifer survival/species composition: Current survival in areas previously planted averages about 100 trees per acre, a 40 percent survival rate. This reflects the effects of one hand release on conifer survival. Survival of three year old trees is lower, averaging about 92 trees per acre. It is expected that even with repeated hand grubbing treatments, conifer mortality would continue to drop because, as described above, moisture stress to conifers would continue. Additional mortality could occur from physical damage to tree seedling’s roots near the soil surface, especially with repeated treatments. Most of the units would suffer enough conifer mortality to fall below the 100 TPA stocking requirement. The Windmiller demonstration plot, located near the Freds fire and described above, has 44 trees per acre at 16 years in the hand release plot.

Because of the density of vegetation outside of the release circles there would be little to no opportunity to interplant or replant. Within the release circles interplanting or replanting could occur. Moving between release circles for grubbing, planting, or survival surveys would be physically difficult where deerbrush, whitethorn, manzanita, and cherry are dominant, increasing costs. Conifer survival on subsequent initial planting and interplanting acres would likely be lower than previously planted acres as the live ground cover of competing vegetation has increased since the fire. Trees planted into the current levels of competing vegetation in the project area would face immediate competition, with survival at age three estimated to be below the current third year survival rate of 40 percent.

Over most of the project area, with repeated hand grubbing and interplanting, conifer survival will continue to drop, threatening plantation failure. The Region 5 FEIS for Vegetation Management for Reforestation (USDA 1989b, table 4-3) estimated 30-60% of the red fir and mixed conifer acres would be stocked with at least recommended levels at age three under a no herbicide management scenario. Currently, 50 percent of the acres with third year survival exams are stocked below 100 TPA. With continued expected mortality from high competing vegetation levels, and limited interplanting opportunities, it is expected that 600-1,100 acres will meet the minimal stocking requirement of 100 trees per acre and be certified as adequately stocked by age ten or sooner (a 60-80 percent of plantations failure rate).

While effective vegetation control is critical for the seedling establishment, it is particularly critical for the establishment of non ponderosa/Jeffrey pine conifers, such as red fir, white fir, Douglas fir, and sugar pine. These species typically have much lower early survival success than ponderosa/Jeffrey pine. The hand release treatments under this alternative would favor the establishment of ponderosa and Jeffrey pine, and the resultant stands would contain high percentages of these pines, with low survival percentages of the other mixed conifer species.

On 800 acres with no reforestation proposed, the effects of this alternative would be similar to the no action alternative.

Aquatic Features: Where planting and hand release are proposed the effects on conifer survival would be similar to upland areas of this alternative, although the availability of water to conifers proximate to these streams may increase conifer survival. Where no release is proposed, the effects on conifers would be similar to the no action alternative. These areas would develop into zones of dense woody vegetation with slower growing conifers.

There would be little to no effect to riparian species, as these species would be protected by no hand release zones along stream courses. Sprouting species such as alders, dogwoods, maples, or willows would continue to recover in riparian areas. These species primarily grow adjacent to streams, springs, seeps, or other areas with water. Riparian species within hand release zones could be cut, but there would be little effect as they would resprout and grow.

Growth: Early stand development (50 years and less) would be considerably slower, and would be less dense than the proposed action. Height and diameter growth would not be substantially different from Alternative 2, although stocking would be higher than Alternative 2. Estimates of growth for this alternative are displayed in Table 3-14, below: Alternative 3 would be similar to the medium shrub category in the Mt. Shasta research paper. As under Alternative 2, these projections assume wildfire can be excluded during each of the time periods. A wildfire within the project area would result in the same effects as Alternative 2.

Table 3-14. Projected Diameter and Height of Conifer at 15 and 50 years (Alternative 3)

Range of Data	15 years old		50 years old		Age for
	DBH	Height	DBH	Height	24 inch trees
Windmiller	2.9	10.2	9.7	34	
SYSTUM-1	4.1	14.8	15.4	60	
Mt. Shasta	2.4	7.8	7.4	24.5	184
FVS					115
Average	3.1	11	10.8	40	

Based on Table 3-14, at the end of 15 years conifers would average about 11 feet in height (range 8 to 15) and have a diameter breast height (DBH) of about 3 inches (range 2 to 4). Average oak height would be taller than conifers, result of early growth from sprouting from established root systems. Their average diameter would about the same as the conifers due to the large stem numbers in a clump. At the end of 50 years conifers would average about 40 feet in height (range 15 to 60) and have a diameter breast height (DBH) of about 11 inches (range 7 to 15).

As discussed under Alternative 2, there is considerable variability in projections beyond 50 years. The trees in the Mt. Shasta study would take approximately 185 years to develop into large trees (≥ 24 inches DBH) assuming a consistent rate of growth beyond the life of the study. It is estimated that the trees under Alternative 3 would take 140-160 years to develop into large trees, due to higher site conditions in the project area.

Under the FVS modeling program, large trees would develop in about 115 years. In planted areas canopy closure is expected to reach 40 percent in about 110 years. A 60 percent canopy level would take slightly longer than 150 years, due to the sparse tree cover (Table 3-12b). The effects conifer growth in unplanted areas would depend on natural regeneration would be the same as unplanted areas under the no action alternative. There would be 800 more unplanted acres than under Alternative 1.

Fuel Reduction Treatments: Masticating shrubs within ¼ mile of Highway 50 (about 388 acres) would have little to no effect on tree growth as most of these shrubs would resprout and recover, using water and nutrients as prior to the treatment. Mechanical damage by the masticating machine or flying debris could cause damage or mortality to trees, but is expected to be minor. Heavily damaged trees could be masticated, which would contribute to lower stocking levels.

Indirect Effects

No plant species will be eliminated from the project area. Within treatment units, all species will persist. Within hand release circles the balance will be shifted toward a greater representation of grasses and forbs in the short-term, followed by an increase of woody shrubs encroaching into the circles. Eventually, conifers will develop and express dominance over the site. Outside of the hand release circles, woody species such as deerbrush, whitethorn, greenleaf manzanita, or bearclover would form a dense closed canopy, dominated by a single species, or a few species. Opportunities for regeneration of other species under this canopy is limited.

Species and structural diversity within stands would be conserved as heritage resource and sensitive plant areas would not be reforested or released. An additional 800 acres would not be reforested under this alternative. Areas with a high concentration of surviving or sprouting oaks would maintain a large abundance of oaks. Natural variations such as surviving conifers, rock outcrops, and riparian areas contribute to diversity. In addition, there would be no hand release zones for varying widths along streamcourses. Species in the outer part of these zones, especially ephemeral and seasonal streams, resemble those of the rest of the unit and would contribute to structural diversity. In the inner portion of these zones, adjacent to live streams, species with high moisture requirements, such as alder, dogwood and willow, would not be treated, contributing to species diversity.

Over the short-term, plant abundance would be unaffected. Over the longer-term, culturally important plants that favor early seral, open conditions would be negatively affected by the horizontal woody brush layer that develops under this alternative, although hand release circles would provide open conditions, at least through the end of the decade.

Risk of loss to wildland fire: Small trees are susceptible to mortality from even the lowest intensity fires. This alternative would result in trees reaching 10 inches DBH in an estimated 29-33 years.

Cumulative Effects

The project area landscape is a combination of private timberlands and public lands. The private timberlands are managed for timber production and therefore will likely develop a mature forest in less than 80-90 years. There are no effects on the development of forest structure on ENF lands as a result of private land activities. The combined effect of these approaches on the landscape will result in a varying pattern of forest structure over the long term. Widespread cumulative effects to culturally important plants are not expected due to the abundance and region-wide distribution of these species.

Climate Change

Affected Environment

This section addresses climate change scenarios as they relate to the severity and frequency of insect outbreaks, and droughts, and their effects on the success of reforestation efforts and adaptive forest management.

The Environmental Protection Agency developed a "State of Knowledge" paper (EPA 2007a) that outlines what is known and what is uncertain about global climate change. The following elements of climate change are known with near certainty:

- Human activities are changing the composition of Earth's atmosphere. Increasing levels of greenhouse gases like carbon dioxide (CO_2) in the atmosphere since pre-industrial times are well-documented and understood.
- The atmospheric buildup of CO_2 and other greenhouse gases is largely the result of human activities such as the burning of fossil fuels.
- An "unequivocal" warming trend of about 1.0 to 1.7 F occurred from 1906-2005. Warming occurred in both the Northern and Southern Hemispheres and over the oceans (IPCC, 2007).
- The major greenhouse gases emitted by human activities remain in the atmosphere for periods ranging from decades to centuries. It is therefore virtually certain that atmospheric concentrations of greenhouse gases will continue to rise over the next few decades.
- Increasing greenhouse gas concentrations tend to warm the planet.

According to EPA (2007), however, it is uncertain how much warming will occur, how fast that warming will occur, and how the warming will affect the rest of the climate system including precipitation patterns.

The Intergovernmental Panel on Climate Change (EPA 2007b) concluded that, for North American forests as a whole:

- Climate change is expected to increase the growth of forests modestly (by 10-20 percent) over the next century. However, extreme and/or long-term climate change scenarios also create the potential for widespread forest decline.
- Disturbances such as wildfires and insect outbreaks are increasing and likely to intensify in a warmer climate with drier soils and longer growing seasons. The forest fire season is likely to lengthen, and the area subject to high fire danger is likely to increase significantly.
- The long-term effects of fire will depend heavily on changes in human fire management activities.

Environmental Consequences

Given what is and is not known about global climate change, the following discussion outlines the effects of this project on carbon sequestration and effects of climate change on reforestation, precipitation, and forest insect and diseases.

Carbon Sequestration: Carbon sequestration was estimated using the Forest Vegetation Simulator using the growth estimates, above. Alternative 1 yields the highest amount of carbon sequestered at all ages modeled (Table 3-15). Carbon sequestration amounts associated with this project are extremely small in the global context, making it impossible to measure the incremental cumulative impact on global climate from carbon sequestration associated with this project.

Table 3-15. Projected Carbon Sequestration (tons per acre) at 50, 100, and 150 Years

	Age 50		Age 100		Age 150	
	Aboveground Live	Total Stand Carbon	Aboveground Live	Total Stand Carbon	Aboveground Live	Total Stand Carbon
Alternative 1	46.1	66.1	80.1	134.5	90.6	157.6
Alternative 2	2.3	6.9	25.0	36.6	50.7	71.3
Alternative 3	5.2	11.3	37.3	53.9	47.9	97.2

Reforestation: Rapid climate change over the next century would likely render many species and local varieties less genetically suited to the environment in which they are currently found. Establishing regeneration may become more difficult since seedlings are often more sensitive to environmental conditions than mature trees (Skinner 2007).

Reforestation under Alternative 1 relies on both national regeneration and planting. Planting prescriptions specify a high diversity of tree species including ponderosa, Jeffrey, and sugar pine, red and white fir, Douglas fir, and incense cedar. The use of seedlings grown from seed of local origin or transferred in compliance with seed transfer rules based on California Tree Seed Zones, (J. Buck et al. 1971; also refer to R-5 FSH 2409.26, Section 42.2) insures high genetic diversity of seedlings. As seedlings will be grown from seed collected from this, or adjacent seed zones, they have the potential to be of higher genetic diversity than seedlings from the immediate project area and may be better suited to the new local environment (Skinner 2007). Replanting diverse species with high genetic diversity means that, overall, reforested stands would have the potential to better adapt to changing conditions over time. Reductions in genetic diversity would likely result from relying fewer acres of planted trees (Alternative 3) or entirely on natural regeneration (Alternative 2).

Precipitation: Variations in yearly precipitation have the potential to affect seedling survival in the short term and growth rates in the longer term. Short term droughts, which are not infrequent in the project area, reduce the total amount of soil moisture on a site. It is the soil moisture available to trees that is the limiting factor affecting seedling survival and growth. Effective control of competing vegetation of during seedling establishment is the key to increasing available soil moisture to trees. Estimates of seedling survival and growth, above, show that Alternative 1 has higher survival and growth rates than Alternative 2 or 3 in the current climate of long moisture free summers. The effect of drought is more likely to affect seedling survival under

Alternatives 2 and 3 due to excessive moisture stress caused by reductions in available soil moisture to seedlings from competing plants.

Changing precipitation regimes in the longer term may result in changes in forest or tree productivity. The productivity of forests for timber in general is estimated to decline on a statewide basis, but some species and in some locations timber production may increase (CAT 2009), while for North America climate change is expected to increase the growth of forests modestly (by 10-20 percent) over the next century (EPA 2007b). Decreased precipitation, in the form of drought, results in higher stress levels within trees as they are not able to obtain the resources necessary for vigorous growth. Established, mature trees are often able to withstand a wide range of environmental conditions and will be able to survive for many years with effects primarily appearing as altered levels of productivity (Skinner 2007). Once established and free to grow, precipitation variability would likely affect tree growth rates under all alternatives more or less, equally.

Forest Insect and Diseases: Factors which improve a stands' ability to better withstand insect and disease outbreaks include a diverse mix of species, high genetic diversity within species, vigorously growing trees, and stocking levels low enough to allow trees to have access to full site resources. Vigorous, healthy trees have a greater ability to successfully ward off insect attacks, and resist diseases. As described above, diverse mix of species, high genetic diversity within species, and vigorously growing trees would be better met under Alternative 1 than Alternatives 2 and 3. Maintaining appropriate stocking levels to resist insect and disease outbreak beyond the implementation of this project is beyond the scope of the EIS.

Invasive Plants

Affected Environment

The current inventory invasive plants in and around the Freds project boundaries include yellow starthistle (*Centaurea solstitialis*), skeletonweed (*Chondrilla juncea*), tall whitetop (*Lepidium latifolium*), and exotic annual grasses, including cheatgrass (*Bromus tectorum)*. Numerous other invasive exotics, which are not thought to form permanent monocultures, such as bull thistle (*Circium vulgare*), Klamathweed (*Hypericum perforatum*), and wooly mullein, are widely scattered in the project area.

Yellow starthistle exists primarily in the western portion of the Freds Fire, especially along Weber Mill Road and its spurs. This infestation is scattered along approximately 5 miles of roadsides. It is being treated under the 2001 Yellow Starthistle Project (USDA 2001c) and has been greatly reduced in size. Yellow starthistle also exists along Granite Springs Road. Three sensitive plant occurrences are located in the vicinity of the yellow starthistle and have been protected by flag and avoid methods.

Cheat grass (*Bromus tectorum)* is widespread on the ENF where it has established itself as a minor component in many plant communities. Cheatgrass is a significant problem throughout the West, including Sierra Nevada foothills and low to mid elevation forests, where it creates fine, flashy fuels that ignite easily resulting in a fast moving fire that can kill established plantations (i.e. St. Pauli Fire July 2002). Surveys in 2006 documented cheatgrass along several roads within the Freds Fire. Twenty two locations were mapped along NFS roads within the fire area.

Skeletonweed and tall whitetop are also documented on or near Granite Springs Road.

The access routes into the Freds Fire begin along Highway 50. Highway 50 west of the Freds Fire is heavily infested with yellow starthistle, scotch broom (*Cytisus scoparius*), skeletonweed, cheat grass and other brome grasses (*Bromus spp.)*, bull thistle, Klamathweed, goat grass (*Aegilops* *triuncialis*), and other weedy species (ENF noxious weed database, 2005; personal observations). The Noxious Weed Assessment can be found in the Project file.

Environmental Consequences

Alternative 1 (Proposed Action)

Direct, Indirect, and Cumulative Effects

In line with one of the objectives of this project, this alternative would contain and control yellow starthistle and eliminate tall whitetop from the project area. The use of the herbicide clopyralid would effectively kill yellow starthistle plants and prevent germination of yellow starthistle seeds where it is applied. The use of the herbicide chlorsulfuron would effectively kill tall whitetop plants and prevent the germination of tall whitetop seeds where applied. Spot treatments with glyphosate would kill any missed plants. Hand treatments would also kill yellow starthistle plants but would be less effective for tall whitetop since plants can resprout from root fragments. This method of control is very time consuming, and would supplement chemical treatments for infestations of yellow starthistle and tall whitetop.

Proposed herbicide treatments for invasive plants will occur in open disturbed areas such as roadsides, landings, and openings areas within plantations. These areas tend to be dominated by non-native grasses and non-native ruderal species, which will limit the potential damage of herbicide use to native non-target vegetation. There is a limited possibility that some native, non-target vegetation would be damaged or killed due to the proposed herbicide treatments. Clopyralid is a selective herbicide; it is only effective on several members of the sunflower family *(Asteraceae*), legume family (*Fabaceae)*, nightshade family (*Solanaceae*), and some species in the knotweed and carrot families. Thus, the effects of clopyralid on non-target vegetation would be minor, as few plant species are affected. Glyphosate is non-selective and can damage or kill sprayed plants. Its use as primarily a spot treatment would reduce damage to non-target vegetation. As a contact herbicide, glyphosate would only affect existing plants. Plants germinating from seeds after a glyphosate treatment would be unaffected. The effects of glyphosate on non-target vegetation would be minor, as relatively few acres would be treated. Chlorsulfuron is a pre-emergent or early post-emergence herbicide that can damage or kill many broadleaf species. Potential effects for non-target native vegetation are minor since the tall whitetop infestation is growing in a disturbed area with few native species and directed foliar application will be used to target invasive plants.

There is some risk of resistance of yellow starthistle to clopyralid herbicide. A Washington population of yellow starthistle developed resistance to repeated picloram treatments. This same population developed resistance to clopyralid (Fuerst et al 1996, in USDA, 2001c). The potential exists for the development of resistance to clopyralid, if repeatedly used year after year. DiTomaso and Orlaff (1997) recommend incorporating other control strategies, or utilizing glyphosate late season to minimize resistance. This alternative incorporates a hand treatment strategy and utilizes glyphosate as a late season treatment. In addition, several biological control agents (insects) are thought to be established on the ENF, although the presence of biological control agents has not been confirmed for the proposed project area (L. Mila, personal communication, 2008). Biocontrol is part of an IPM program as it can reduce densities and subsequent damage by invasive plants.

Invasive Plant Spread: The project area is still recovering from the 2004 wildfire and the 2005 salvage operations. Due to availability of additional nutrients after the fire, exposed mineral soil, and extensive soil disturbance that occurred during fire suppression and salvage operations, the fire area provides an excellent seedbed for exotic, invasive plants. Once these super competitors become established (many species form monocultures) they can adversely effect native plant communities, including sensitive plant species, by crowding, shading, and robbing soil of nutrients and water necessary for growth and survival.

Over the short-term (<5 years) it is expected that there will be an increased risk of invasive plant spread resulting from the reduction in native vegetation cover after broadcast herbicide treatments. The radial treatments proposed where infestations of yellow starthistle and cheatgrass have been documented (about 510 acres) are designed to limit the potential for invasive plant spread. This configuration will allow for continued growth of shrubs and other native vegetation outside the radial pattern. To the degree that vegetation outside the radial spray pattern shades the ground and robs cheatgrass of sunlight, cheatgrass expansion will be inhibited. which may over a few years, reduce density and eventually shade out cheatgrass, which has little tolerance for shade.

Longer-term indirect effects could result from a reduced risk of invasive plant spread with the establishment of a forested landscape. In the event of another fire within the project area in the foreseeable future (25+ years), the project activities under this alternative will be more effective at containing a fire at a smaller size, increasing the probability of seedling survival across the landscape (Chapter 3 - Fire and Fuels). To the extent that the proposed action will limit the potential scale of future wildfires within the proposed project area, the probability of a mature forested landscape, which are relatively resilient to invasive plant spread, developing across a majority of the project area will increase.

Vectors (vehicles, dispersed recreation, water, wind, wildlife) and disturbances (roads, timber harvest, fuel treatment) would continue to be present on NFS land. These factors have contributed in the past and currently to the establishment of invasive plants on the Forest. Weed risk assessments have been conducted on the ENF since 2001 to “determine risks for weed spread … associated with different types of proposed management activities” (SNFPA Record of Decision, Appendix A, page A-55 and FSM 2080). Project-specific mitigations, incorporated into all new projects on the Forest, should reduce the potential spread of invasive into the project area in the future.

There are private lands within and adjacent to the proposed project area. Since it is unknown what measures are in place to prevent the spread and introduction of invasive plants it should be assumed that present and future activities by the public and adjacent landowners could facilitate the spread of invasive plants into the proposed project area

Alternative 1 will mitigate potential cumulative effects from this project by 1) containing known infestations of starthistle 2) eliminating known infestations of tall whitetop 3) establishing radial treatments within areas infested with cheatgrass to reduce the potential spread of this annual grass, and 4) developing a mature forested landscape that is relatively resilient to invasive plant spread. These measures will reduce the potential for cumulative effects in the project area. To the extent Alternative 1 is successful in developing a forested landscape, it is expected to have less cumulative effects overall than Alternative 2 or 3. New infestations within the project area will be subject to additional environmental analysis prior to implementing control strategies.

Alternative 2 (No Action)

Direct, Indirect, and Cumulative Effects

There will be no direct effects to invasive plants. In portions of the project area, yellow starthistle is being treated and treatment would continue, limiting spread. Tall whitetop would remain tarped and plants that emerge from under the tarp would continue to be hand pulled. Elsewhere, yellow starthistle and tall whitetop, introduced during past activities, would continue to grow and spread limited only by environmental factors, potentially negatively affecting native vegetation. One of the most immediate effects of weed invasion is the displacement of native plants (USDA, 2001b). This alternative would not meet the project objective of containing and controlling yellow starthistle. It is unlikely that the tall whitetop infestation would be eliminated under this alternative. Tall whitetop possesses a vigorously creeping, deep root system that reproduces vegetatively from roots. These vigorously creeping root systems would continually sprout from around the edges of the tarped area, requiring ongoing maintenance to be effective. Cheatgrass would likely continue to persist in open areas where it is dominant and along roadsides. Eventually dense growth of native shrubs and other plants may shade-out small, dispersed infestations of this annual grass.

In the short-term (<25 years) there will be a reduced risk for both introduction and spreading of weeds within the project area. Invasive plants will persist in openings, but without disturbance they are unlikely to spread within the project area because of the dense cover of native shrubs (Bossard, 2000). Longer-term (> 25 years), the risk of high intensity crown-fires is believed to increase as mature shrubs senescence. To the extent that the no action alternative increases the risk of large-scale high severity fire, there could be indirect impacts to invasive plants. Fire suppression activities during large uncontrolled wildfires may increase the spread of invasive plant species. The open ground created by an intense wildfire could potentially facilitate invasive plant expansion.

Existing infestations will continue to spread unchecked, gaining increasing dominance over the long term, contributing significantly to the cumulative effects of past and present weed infestations. A higher risk of a large uncontrolled wildfire could facilitate invasive plant expansion, contributing to cumulative effects. New and existing infestations within the project area will be subject to additional environmental analysis prior to implementing control strategies.

Alternative 3

Direct, Indirect, and Cumulative Effects

This alternative would treat yellow starthistle in the project area by hand methods. Various locations on the ENF have had yellow starthistle hand pulled, including sites along Webber Mill Road, Traverse Creek and Peavine Ridge Road. It is difficult to quantify the benefit, but it appears to be rather small, based on post-treatment observations. Hand treatments are highly labor intensive and very time consuming. Germination of starthistle plants later in the year would require more than one, probably two to three treatments on a yearly basis, until the seedbank was exhausted. Hand methods for controlling yellow starthistle are primarily recommended for small areas or low densities (see, for example, Callihan 1998, University of California 1996, Province of British Columbia 1998, in USDA, 2001c). While hand methods appear successful when applied intensively and correctly on a small scale, applying hand treatments alone, considering the size of the yellow starthistle infestation in the project area, is unlikely to meet the project objective of containing and controlling yellow starthistle. While the vegetation complex that develops under this alternative – a nearly continuous expanse of brush interspersed by grubbing circles - would slow yellow starthistle spread, it would also hinder access to plants by hand pullers. If an intense fire occurred in the future, it would provide open ground for starthistle expansion from plants inhabiting open areas, such as roadsides and openings.

This alternative would treat tall whitetop in the project area with hand methods (hand pulling, tarping). Since this infestation is small, both hand pulling and tarping methods are expected to meet the project objective of eliminating this plant. Tall whitetop possesses a vigorously creeping, deep root system that reproduces vegetatively from roots or root fragments. Continued growth from remaining root fragments after hand pulling treatments would require more than one, probably two to three treatments on a yearly basis, until the plants exhausted their food reserve. Similarly, vigorously creeping root systems would sprout from around the edges of a tarped area, requiring ongoing maintenance to be effective. Monitoring for several years will determine the status of the tall whitetop infestation.

In the short-term (<25 years) there will be a reduced risk for both introduction and spreading of weeds within the project area, especially cheatgrass, although the ground disturbance adjacent to planted trees is likely to create ideal growing conditions for weed seeds present in the scalped area. The potential for weed expansion outside of the planted tree radius will be diminished due to a greater cover of native plants that shade the ground thus inhibiting the germination and growth of invasive plants.

The risk of longer-term indirect effects for invasive plants would be similar to Alternative 2 as the expected increase in long-term (>25 year) risk for high severity fire is expected to be similar to Alternative 2 (no action).

Alternative 3 will mitigate potential cumulative effects from this project by 1) eliminating known infestations of tall whitetop and 2) utilizing radial treatments, reducing the potential spread of cheatgrass. The potential for cumulative effects from hand treatments of yellow starthistle would remain as this method would be ineffective in containing known infestations of yellow starthistle, allowing further spread. The increased long-term risk of high severity wildfire could potentially facilitate invasive plant expansion, contributing to cumulative effects. New and existing infestations within the project area will be subject to additional environmental analysis prior to implementing other control strategies.

Botanical Resources

Affected Environment

Elevations within the project area range from 3,900 to 6,800 feet. The vegetation within the project area consists primarily of a mid-montane mixed conifer forests with white fir dominating at the higher elevations in the north and ponderosa pine dominant in the lower elevations to the south. The lowest elevations are characterized by ponderosa pine, black oak and scattered areas of open, rocky ground with live oak interspersed. In the western portion where the Freds Fire overlapped with the 1992 Cleveland Fire, plantations of ponderosa pines with a significant resprouted black oak component are dominant.

The botanical resources of the analysis area are incompletely known. Sensitive plant surveys of the general area have been occurring since the early 1990’s. These surveys, for the most part, have been focused on one sensitive species, Pleasant Valley mariposa lily (*Calochortus clavatus* var. *avius*).

It is possible, perhaps likely, that sensitive plant locations remain undiscovered on both NFS and private lands within the Freds Fire analysis area. In the following discussion on effects of the alternatives, analysis area refers only to NFS lands.

Federally Listed Plant Species

No Federal proposed, threatened or endangered plant species are documented in the analysis area (USDI Fish and Wildlife Service, 2009). The Biological Evaluation (BE) for Plants can be found in the Project file.

Sensitive Plant Species

There are 22 sensitive plant species currently listed by the Regional Forester for the Eldorado National Forest. A pre-field evaluation determined that five sensitive species, Pleasant Valley mariposa lily (*Calochortus clavatus* var. *avius*), Kellogg's lewisia (*Lewisia kelloggii*), mountain lady's slipper (*Cypripedium montanum*), two mosses (*Meesia* spp.), and the moonwort complex (*Botrychium* spp.), had potentially suitable habitat in the analysis area. Subsequent surveys of potential habitat for these species located no new occurrences.

Potential habitat surveys for mountain lady's slipper and the moonwort complex were found to be unsuitable. Potential habitat surveys for two mosses (*Meesia* spp.) were marginally suitable at best.

Pleasant Valley mariposa lily

Suitable habitat for Pleasant Valley mariposa lily consists of openings in mixed conifer and ponderosa pine forests, on canyon slopes, spurs, and ridges with southerly aspects, at elevations of 2,800 to 5,800 feet. These openings typically have rocky soils with surface rocks and cobbles readily apparent.

With a single exception in Calaveras County, Pleasant Valley mariposa lily is endemic to the ENF and adjoining private lands in the area between Union Valley Reservoir and the North Fork of the Mokelumne River and is currently known to occur at 124 locations within this roughly 420 square-mile area (Forest maps/Sensitive Plant files 2006). Of these 124 occurrences, 12 are located on private lands, 4 are located on both private and Forest Service lands and the remaining 108 occur entirely on federal lands. Four known occurrences of Pleasant Valley mariposa lily are documented within the fire area.

Kellogg's Lewisia

Kellogg's lewisia is restricted to a specialized habitat usually on ridgetops or relatively flat open areas with widely spaced trees in partial to full sun. Site elevations range from 5,100 to 7,000 feet. Most soils are reported to be sandy granitic to erosive volcanic with granitic boulders. Plants are often visible during June and July and then seem to dry up and disappear later in the summer. The reason for the apparent disappearance has not been resolved. Either the plants may be subject to poaching, are desirable forage for wildlife or they simply dry up and shrivel beyond the point of recognition.

Kellogg's lewisia is known from at least 30 occurrences in four National Forests from Plumas County to Madera County. The northern most occurrence is known from the Lassen National Forest but the number of plants was not clearly noted. The largest occurrence (about 2,000) is on the ENF, but most other occurrences range in number from 50 to 250 plants. No occurrences of Kellogg's lewisia are documented within the fire area.

Special Interest Species (Watchlist)

Three Forest special interest species, lace orchid (*Piperia leptopetala*), mariposa phacelia (*Phacelia vallicola*), and woolly violet (*Viola tomentosa*) are suspected to occur within the analysis area. Special interest species make up a Forest watch list of plants that are not currently rare, but may become increasingly so as a result of project activities. Current Forest Service policy does not require formal tracking of special interest species; therefore, data for these species are not always available or up-to-date.

Environmental Consequences

There are no Federal proposed, threatened or endangered plant species documented in the analysis area. Therefore, there would be no impacts from any of the alternatives in this project to such species. The BE has determined that there would no effect to mountain lady's slipper (*Cypripedium montanum*), two mosses (*Meesia* spp.), and the moonwort complex (*Botrychium* spp.), as there is no suitable habitat or their habitat will be protected from project activities (Alternative 1 and 3) by buffers created around aquatic features such as meadows, fens, and along riparian corridors will serve to protect riparian vegetation. There would be no effect on these species from Alternative 2 (no action).

Alternative 1 (Proposed Action)

Direct Effects

There will be no direct effects to known occurrences of Pleasant Valley mariposa lily as they will be flagged for avoidance and monitored after planting and herbicide applications. Little or no damage from herbicide drift or runoff is expected when applying glyphosate by backpack herbicide application (SERA 2003a). In addition, past conifer release and invasive plant herbicide treatments have occurred on the ENF adjacent to Pleasant Valley Mariposa lily without any observed effects to the sensitive species.

There will be no direct effects to any new occurrences of sensitive species found during subsequent surveys, or any time prior to or during project implementation, as they will be documented and flagged for avoidance.

Although sensitive plant occurrences will be protected by avoidance, potentially suitable habitats for Pleasant Valley mariposa lily and Kellogg's lewisia may be adversely affected by proposed management activities under this alternative. Small, inconspicuous seedlings of Pleasant Valley mariposa lily and Kellogg's lewisia may inadvertently be killed by spray treatments in unprotected suitable habitat. While these activities will not be sufficient to affect the overall viability of these sensitive species, they can reduce opportunities for enhancing species viability and presence within the analysis area.

The risk of direct effects to undiscovered individuals within potential habitat is dependent on the frequency and season of the herbicide treatments. Treatments that occur after sensitive species become dormant in mid to late summer are less likely to effect undocumented individual plants. Mature plants of both species have relatively large underground storage structures, therefore it is possible that individual plants could survive a single inadvertent direct exposure to herbicide (ENF sensitive plant files).

The risk of direct effects to undocumented sensitive species is also dependent on the extent of herbicide treatments. Impacts are less likely to occur on the approximately 15% of the project area where radial treatments are proposed than where broadcast treatments are proposed.

If present in the proposed planted areas, Forest special interest species (woolly violet, lace orchid and mariposa phacelia) may be affected by planting and, more likely, by the herbicide treatments planned in this alternative. Seed bank reserves may allow for regrowth in the seasons after treatment.

Indirect Effects

Short-term indirect effects to sensitive plants could result from increased competition with invasive plants. Over the short-term (<5 years) it is expected that there will be an increased risk of invasive plant spread resulting from the reduction in native vegetation cover after herbicide treatments. Indirect effects resulting from competition (shading, loss of nutrients and water) from invading weeds can reduce populations and/or displace sensitive plants such as Pleasant Valley marisposa lily and Kellogg's lewisia. The project activities and design features, treating yellow starthistle, modified treatment areas for the cheatgrass infestations, and monitoring of current and future project activities that can introduce new weeds or cause expansion of existing infestations, will serve to reduce the likelihood that indirect effects to sensitive plant habitats or occurrences will occur.

Longer-term indirect effects could result from a reduced risk of invasive plant spread with the establishment of a forested landscape. In the event of another fire within the project area in the foreseeable future (20+ years), the project activities under this alternative will be more effective at containing a fire at a smaller size, increasing the probability of seedling survival across the landscape (Chapter 3 -Fire and Fuels). To the extent that the proposed action will limit the potential scale of future wildfires within the proposed project area, the probability of a mature forested landscape developing across a majority of the project area will increase. Since mature forested landscapes are relatively resilient to invasive plant spread the above reduction in fuel loading may indirectly benefit sensitive plants within the project area in the long-term.

Cumulative Effects

Cumulative effects for sensitive plant species consider the impacts of the Alternative 1 when combined with the following past, present, and foreseeable future actions and events within the project area: soil disturbance and compaction resulting from past salvage logging, firelines, and existing road conditions. The actions contributing to cumulative effects were selected because they have caused or have the potential to adversely affect either sensitive plant species themselves or their suitable habitat. The geographic scope of the cumulative effects analysis was selected because impacts to sensitive plant species accumulate at a given location on the ground, irrespective of actions in surrounding areas. The temporal scope was selected because impacts to sensitive plant species at a given location can accumulate over time from different activities or events.

Cumulative effects also include past fire suppression and BAER activities and the actions taken by the private landowners in the project area. The cumulative effects also consider impacts from private industry's salvage and reforestation; past fire suppression (Wrights Fire, Cleveland Fire, Freds Fire) including application of retardant, the emergency BAER treatments, reforestation of burned over plantations on public lands; effects of invasive plants and ongoing treatments; past timber and fuels project (Freds Fire Salvage Sales, Algorythym Roadside Hazard, 4 Corners, Misnomer and Jane Doe Understory thinning); planned or recent thinning/timber sales (Roadrunner Fuels treatment); and vegetation management in Cleveland Fire plantations.

Because of previous survey efforts, protection measures, and weed abatement projects on NFS lands these activities are not expected to have significant cumulative effects on the sensitive plant species occurring in the Freds Fire nor lead toward a loss of viability or possible federal or state listing for those sensitive plant species. Direct effects from Alternative 1 will be mitigated, in a large part, by protection of documented occurrences of sensitive plants through avoidance. Direct effects may occur to undiscovered individuals or occurrences of sensitive species located outside the flagged boundaries of documented sites on NFS land and those found on private land within the project area. Because of the relatively small size of the affected area, indirect and cumulative effects of Alternative 1 will not reduce the viability of the sensitive species that are present in the fire area although project activities may eliminate or reduce opportunities for enhancing and increasing their viability within the fire. In summary, the Proposed Action Alternative may affect individuals but is not likely to result in a trend toward federal listing for Pleasant Valley mariposa lily and Kellogg's lewisia.

The three Forest special interest species within the Freds Fire have evolved in fire-prone landscapes. Although the effects of the Freds Fire and Alternative 1 may reduce the presence of these species in the fire area, it is not expected to reduce their range-wide viability as they are broadly distributed within California.

Alternative 2 (No Action)

Direct, Indirect, and Cumulative Effects

There will be no direct effects sensitive plants and Forest special interest species as no activities are proposed under this alternative. Vegetation succession to continue within the analysis area without further disturbance from management activities. 1,868 acres have been planted with conifers since the fire. While these plantations began the successional process "fully stocked" with conifers, conifer survival and growth are expected to be reduced when compared to Alternative 1, based on current trends.

Sensitive plants within the project area occur in natural openings defined by rocky, low-productive soils. These sites are not dominated by dense shrub cover and are unlikely to be negatively effected by encroaching shrubs. Undocumented sensitive species found in riparian habitats are also unlikely to be impacted by the expected dominance of native shrub species within the project area. If present in the analysis area special interest species are expected recover from effects of the wildfire and salvage disturbances. These species evolved in fire-prone landscapes.

Short-term indirect effects to sensitive plants and Forest special interest species are not expected. For the short-term (<5 years) the risk of invasive plant spread within the proposed project area is expected to be less under this alternative than under Alternative 1. Invasive plants will persist in openings, but are unlikely to spread within the project area because of the dense cover of native shrubs (Bossard, 2000). The percent cover of native vegetation is expected to remain high across the project area for the foreseeable future, thereby reducing the risk of invasive plant spread, unless another large-scale fire occurs.

Initially the plant community will be dominated by native shrubs with native and non-native grasses in the understory. This plant community would produce a moderate fire, with expected flame lengths of 5.5 feet (Chapter 3 – Fire and Fuels). Once these native shrubs mature, dead woody material is expected to accumulate in the shrub canopy and will support higher severity fire with expected flame lengths of 15.1 feet. This transition from moderate to severe fire severity is expected to take approximately 20 years.

Longer-term indirect effects could result in an increased risk of invasive plant spread and changes to habitat in the event of a high severity wildfire. After 20 years, the risk of high intensity crown-fires is believed to increase as mature shrubs senescence. In the event of another high severity wildfire in the project area it is expected that there could be some indirect effects to sensitive plant species. High intensity crown-fires in the Sierra Nevada tend to result in homogenous conditions post-fire with less diversity of understory plant species when compared to low-intensity underburns (Knapp and Keeley, 2006). High-intensity wildfires also result in accelerated erosion, sedimentation, and altered hydrologic processes, all of which could negatively affect habitat quality for sensitive plant species (Neary et al, 2005). In addition, fire-suppression activities during large uncontrolled wildfires may increase the spread of invasive plant species which could negatively impact potential and occupied habitat for sensitive plants (Zouhar et al, 2008). Together, these studies suggest that uncontrolled high-intensity wildfires would likely impact many sensitive plant species by altering habitat quality and potentially facilitating the spread of invasive plants. To the extent that the no action alternative increases the risk of large-scale high severity fire, there could be indirect impacts to sensitive plants in the future (>20 years).

It is likely that sensitive plant species that occur on private forest land owned by Sierra Pacific Industries have been impacted by salvage logging, planting and release treatments. The ENF has no documentation of sensitive plant locations on Sierra Pacific Industries land within the Freds Fire area nor is aware of any sensitive plant mitigation measures taken by Sierra Pacific Industries during Freds Fire salvage or planting projects.

Alternative 3

Direct, indirect, and cumulative effects to sensitive and Forest special interest plants and their habitats under this alternative would be similar to the proposed action except as follows.

Direct Effects

The potential for direct effects to undocumented sensitive plants in potential habitat is significantly reduced compared to Alternative 1 due to 800 fewer acres planted/released and the subsequent reduction in area included in release treatments.

Release treatments in this alternative are limited to the disturbance caused by hand grubbing a 4-5 foot radius around planted trees. Inconspicuous seedlings of sensitive plants outside of a 4-5 foot radius from planted trees are much less likely to be injured or killed by release activities.

This alternative would provide for enhanced species viability and potential expansion (recruitment) within the analysis area.

Indirect Effects

Short-term indirect effects to sensitive plants could result from increased competition with invasive plants, however they would likely be limited to the hand release radius around planted trees. Within the 5 foot hand release radius around planted trees certain early maturing annual weeds, such as cheatgrass, may increase due to enhanced germination opportunities caused by the disturbed soil.

The potential for indirect effects to sensitive plants from weed expansion outside of the planted tree radius will be diminished due to a greater cover of native plants that shade the ground thus inhibiting the germination and growth of invasive weeds, including cheatgrass.

The risk of longer-term indirect effects for sensitive plant species would be similar to those described under Alternative 2 as the expected increase in long-term (>20 year) risk for high severity fire is expected to be similar to Alternative 2 (Chapter 3- Fire and Fuels).

Cumulative Effects

Cumulative effects to sensitive species will be somewhat reduced due to a reduction of 800 acres being planted and released. This diminishes the opportunities for direct and indirect effects to potentially undiscovered plants. Radial hand release treatments reduce the total acres impacted by release treatments when compared to broadcast herbicide treatments prescribed under Alternative 1. This may allow sensitive plants to potentially expand into adjacent suitable habitat of poorer productivity (low site index) as this habitat typically supports fewer plants and shrubs. In summary, the Alternative 3 may affect individuals but is not likely to result in a trend toward federal listing for Pleasant Valley mariposa lily and Kellogg’s lewisia.

Economic Analysis

Affected Environment

The Eldorado National Forest’s economic area of impact consists of Alpine, Amador, El Dorado, and Placer Counties. The project area is wholly within El Dorado County, on the Placerville and Pacific Ranger Districts. El Dorado County’s economic base includes tourism, recreation, lumber and wood products, and agriculture. Placerville and Pacific Ranger Districts contribute to the regional economy in two primary ways: through generation of income and employment for residents in the immediate area, and through direct and indirect contributions to local county revenues. The Districts also contribute in secondary ways, such as through the production of commodities that are consumed in local and regional markets. The proposed forest management activities most directly impact this county’s residents in terms of local social and economic impacts. Relative to the local economy, employment opportunities would be created from this project from tree planting, site preparation and release, invasive plant treatments, and fuel reduction treatments. Furthermore, indirect and induced economic employment and monies would be generated when income received by contractors is spent within the local economy.

Environmental Consequences

The economic consequences are a measure of the overall value of alternatives for managing the project area. The level and mix of goods and services available to the public varies by alternative, which creates impacts on the social and economic environment. The impacts discussed in this section include estimated government expenditures and revenues, as well as monetary impacts on local communities.

The direct monetary impacts are discussed in terms of net cash value to the U.S. Treasury, including the direct, indirect, and induced job opportunities. In general, the monetary value of the alternatives depends on the amount and method planned for fuels reduction, site preparation, release, invasive plant, and reforestation treatments.

Employment

Employment effects on the local economy can be defined in terms of direct, indirect, and induced. Direct effects are associated with the primary producer. On this project, mechanical and chemical treatments have a direct effect on employment by contractors spending money at hotels, restaurants, parts and equipment, supply and retail stores. Indirect effects account for employment in these service industries, which serve the contractor. These service industries in turn would spend money to other service industries or suppliers and pay wages to employees. Wages paid to workers by the direct and indirect industries are then circulated through the local economy for food, housing, transportation, and other living expenses, which is an induced economic effect. The sum of direct, indirect, and induced effects is the total economic impact in terms of jobs.

Treatment Costs

The primary factors affecting costs are: reforestation costs, based on the method and amount of site preparation, planting and release required, invasive plant treatment costs, based on the method and amount of treatments required, fuels reduction costs, and monitoring requirements; depending on the method and amount of projects. Costs to implement each alternative differ because of the method and amount of activities under each alternative. An economic analysis provides a means to rank the relative economic cost/value of the vegetation management alternatives within the Freds Fire area.

Non-Priced Costs and Benefits

Assessing economic value is complex, since vegetation management can yield many long-term benefits that are not easily quantifiable in monetary terms, e.g., wildlife habitat associated with late successional forests, protection of soils and water resources from the effects of large-scale wildfire, scenic values, etc. Thus, this analysis does not include monetary values assigned to resource outputs such as wildlife, watershed, soils, recreation, timber outputs, controlling invasive plants, firefighting costs, and fisheries. It is intended only as a relative measure of differences between alternatives based on those direct costs and values used. Other values are discussed in the appropriate section of this document. It should be noted that all costs and values are not represented in the analysis. The calculations do not include costs and values for those items that cannot be estimated in dollar terms. Examples of costs not estimated in dollar terms are the reduction in scenic value in the early years of reforestation treatments or the decrease in water production as forests are re-established. Examples of benefits not estimated include the accelerated restoration of a forested ecosystem; reduction of fuels and fire hazards; improved habitat for wildlife dependent on forested environments; improved visual quality and aesthetic values; and an improved environment for recreational use within the project area.

For a discussion of these non-priced benefits and costs, refer to the sections of the document where the effects by alternative are described. These non-priced benefits and costs must be considered along with the net economic value of each alternative in order to make a judgment as to which alternative offers the best overall mix of costs and benefits to society.

Alternative 1 (Proposed Action)

Direct Effects

Implementation of the reforestation, fuels reduction, and invasive plant treatments for this alternative is estimated to cost $2,530,000 (Appendix E). As described above, this economic analysis does not take into account non-priced benefits. The cost on an acre basis is approximately $762 per acre. This dollar value per acre includes the cumulative or multiple treatments (i.e., site preparation, planting, release, invasive plants) being completed on the same acres.

Site preparation, planting, release, and fuel reduction activities would generate 4,903 person days worth of employment opportunities. The use of herbicide application has higher rates of production, but requires more contract supervision. It would require fewer days to accomplish, but with more people involved in contract supervision.

Indirect Effects

Additional employment opportunities would be created in service industries that serve the reforestation and fuel reduction contractors, such as tractor supply companies, fuel supplies, and so forth. Induced effects, wages that are paid to workers by the primary (4,903 person days) and service industries would be circulated through the local economy for food, housing, transportation, and other living expenses.

Cumulative Effects

On the Placerville and Pacific Ranger Districts, there are no active reforestation projects. The Freds Fire Reforestation Project would continue to contribute to the local economy. Reforestation activities on the Georgetown Ranger District and on the Amador Ranger District, have contributed recently, and may continue to contribute to the local economy. Reforestation activities on private land in the analysis area are primarily Sierra Pacific Industries, which is in the process of reforesting about 2,526 acres. These activities have contributed recently, and may continue to contribute to the local economy.

Alternative 2 (No Action)

Direct Effects

This alternative would not reforest or reduce the fuels in the project area. No employment opportunities would be generated from reforestation and fuel reduction activities. Monies spent on reforestation efforts to date would cease. Any future treatments would also be at higher cost than at present.

Indirect Effects

No additional employment opportunities or wages paid to the primary and service industries employees would be circulated through the local economy.

Cumulative Effects

With no direct or indirect effects, there are no cumulative effects.

Alternative 3

Direct Effects

Implementation of the reforestation, fuels reduction, and invasive plant treatments for this alternative would cost $4,688,000 (Appendix E). The economic analysis does not take into account the non-priced benefits. The cost on a acre basis is approximately $1,906 per acre, for 800 less acres reforested. This dollar value per acre includes the cumulative or multiple treatments (i.e., planting, release) being completed on the same acres.

Planting, release, and fuel reduction activities would generate 15,600 person days worth of employment opportunities. The use of hand release, which has lower rates of production, but requires less contract supervision, would more days to accomplish, but with fewer people involved in contract supervision.

Indirect Effects

Additional employment opportunities would be created in service industries that serve the reforestation and fuel reduction contractors, such as tractor supply companies, fuel supplies, and so forth. Induced effects, wages that are paid to workers by the primary (15,600 person days) and service industries would be circulated through the local economy for food, housing, transportation, and other living expenses.

Cumulative Effects

On the Placerville and Pacific Ranger Districts, there are no active reforestation projects. The Freds Fire Reforestation Project would continue to contribute to the local economy. Reforestation activities on the Georgetown Ranger District and on the Amador Ranger District, have contributed recently, and may continue to contribute to the local economy. Reforestation activities on private land in the analysis area are primarily Sierra Pacific Industries, which is in the process of reforesting about 2,526 acres. These activities have contributed recently, and may continue to contribute to the local economy.

Heritage Resources

Affected Environment

Heritage resources, the remains of past human activity, provide a record of human activity within the ecosystem and provide a meaningful context for resource managers to assess the existing condition of a landscape. The Fred's Fire analysis area contains evidence of human activity over a long period of time, with the heaviest use occurring within the last 4,000 years. Materials from the surrounding forest indicate that people have been visiting the general vicinity for at least 7,000 years.

By 5,000 years ago, permanent villages were well established on the western Sierran slopes at elevations generally below the snow line. Inhabitants of those villages, as well as people from the east side of the Sierra, were visiting the higher elevations of the forest to procure resources not available in the lower elevations. Three different groups were using the resources of the forest. Two of them, the Nisenan (Southern Maidu) and the Northern Sierra Miwok, had their winter villages below the snow line on the west slope of the Sierra. The Washoe had their permanent villages east of the Sierra, in the Reno and Markleeville area. All three groups may have used the area. One area near Sugarloaf, in Kyburz, was used as a meeting ground for Big Times. During the summer and fall these groups traveled through the area to acquire a variety of resources, some through trade. Archaeological evidence confirms seasonal use due to the presence of temporary camps containing bedrock milling features and lithics.

Historic activities also left important remains on the landscape within the analysis area. During the late 1840s through the 1850s, the rush for gold brought thousands of immigrants from around the world to the Sierra Nevada. Homesteads, cabins and other structures; ranches, corrals and other ranching features; mines and hydraulic pits; ditches; dams; trails and wagon roads; toll stations; hotels, hostelries, and way stations; historic refuse scatters associated with this era have been identified within the project vicinity.

Past surveys have been adequate to assess the effects of the proposed actions. Since 1980, archaeological surveys have resulted in coverage of the majority of the public land within the analysis area. In addition, new survey was completed after the Fred's Fire (documented in Archaeological Reconnaissance Report No. R-2005-0503-60001.) All archaeologically sensitive terrain has been surveyed. Some areas have not been surveyed due to steepness of terrain. However, it is not likely that these areas contain significant heritage resources. These surveys have resulted in the identification of a total of 20 sites. Of this total, 10 sites are prehistoric (Native American), 9 are historic, and one site contains both Native American and historic artifacts. At present, none of these sites have been evaluated for inclusion into the National Register of Historic Places. In order for a heritage resource to be considered for inclusion, its significance and integrity need to be determined.

The Freds Fire considerably affected the integrity of these sites. The effects from the wildfire ranged from charring, spalling, discoloring, melting, and destroying individual artifacts to complete destruction of wooden features.

These sites will continue to experience negative effects from the wildfire as the areas that suffered a loss of vegetation and damage to the soil structure will be susceptible to higher erosion rates, changes in drainage patterns and slide activity. Additionally, in heavily forested areas, damage from falling dead trees is likely.

Environmental Consequences

All Alternatives

Direct and Indirect Effects

Implementation of this project is not expected to have any direct effects on known cultural resource sites located within the analysis area. Ground-disturbing activities associated with Alternatives 1 and 3 have the potential to disturb or destroy heritage resources. Twenty heritage resource sites within the Freds Fire perimeter are located within areas of proposed ground-disturbing activities. However, protection of heritage resource sites is included as part of the project design.

Activities associated with this alternative will comply with the National Historic Preservation Act (NHPA) of 1966, as amended and it's implementing regulations 36 CFR 800. Tribal communities will continue to be consulted for any concerns regarding this project.

Protection of cultural resource sites will comply with the Programmatic Agreement among the USDA Forest Service, Pacific Southwest Region, California State Historic Preservation Officer, and Advisory Council on Historic Preservation Officer Regarding the Identification, Evaluation and Treatment of Historic Properties Managed by the National Forest of the Sierra Nevada, California dated 1996. Protection measures outlined in the Programmatic Agreement will be followed throughout the duration of project activities.

Cumulative Effects

Past events, both natural and human caused, have had varying levels of cumulative effects on the archaeological sites in the project area. These effects, ranging from moderate to extensive, have resulted from logging, road construction, wildfires, erosion, and exposure to the elements. No predicted future management activities will affect heritage resources. However, future wildfires will continue to degrade the integrity of these fragile heritage resources.

Without management intervention there is a concern for future high severity fires within the sites due to increased fuel loading from downed fire killed trees and the presence of dense brush fields, which tend to replace timber after stand replacing fire events.

Human Health and Safety of Herbicide Use

Affected Environment

Alternatives 2 and 3 do not propose to use herbicides, therefore this section on Human Health and Safety of Herbicide Use is only discussed in terms of Alternative 1 (Proposed Action).

The risk of adverse health effects from the use of any of the five herbicides proposed for use on the level and duration of exposure and the inherent toxicity of the herbicide. Possible short-term adverse health effects include nausea, headache, dizziness, eye irritation, and coughing.

A comprehensive analysis of human health risks was conducted to analyze the potential for adverse health effects in workers and members of the public from the proposed use of herbicides. This analysis examines a range of potential exposures to herbicides, from routine operations involving workers, to accidents involving workers and the public. Assumptions regarding rates of use range from average (or typical) rates of use to very high rates of use, representing worst-case scenarios. Appendix D presents the complete risk assessment. The following summary of herbicide effects is taken from that risk assessment.

This risk assessment examines the potential health effects on all groups of people who might be exposed to any of the five herbicides proposed to be used. Those potentially at risk fall into two groups: workers and members of the public. Workers include applicators, supervisors, and other personnel directly involved in the application of herbicides. The public includes other forest workers, forest visitors, and nearby residents who could be exposed through the drift of herbicide spray droplets, through contact with sprayed vegetation, or by eating, or placing in the mouth, food items or other plant materials, such as berries or shoots growing in or near treated areas, by eating game or fish containing herbicide residues, or by drinking water that contains such residues.

The analysis of the potential human health effects of the use of chemical herbicides was accomplished using the methodology generally accepted by the scientific community (National Research Council 1983, United States Environmental Protection Agency 1986). In essence, the risk assessment consists of comparing doses, based on site-specific herbicide use levels, that people might receive from applying the herbicides (worker doses) or from being near an application site (public doses) with the United States Environmental Protection Agency's (U. S. EPA) established Reference Doses (RfD), a level of exposure considered protective of lifetime or chronic exposures. The site-specific risk assessment also examines the potential for these treatments to cause synergistic effects, cumulative effects, and effects on sensitive individuals, including women and children.

Different types of possible effects were considered in the assessment, including acute and chronic systemic effects, cancer and mutations, and reproductive effects. These effects were evaluated using the appropriate animal test data. General systemic effects were evaluated that could range from nausea and headaches at low doses to organ damage, reproductive problems, birth defects, or even mortality at extreme doses. This risk assessment also examined acute toxic effects from accidental exposure scenarios. For each type of dose assumed for workers and the public, a hazard quotient (HQ) was computed by dividing the dose by the RfD. In general, if HQ is less than or equal to 1, the risk of effects is considered negligible. Because HQ values are based on RfDs, which are thresholds for cumulative exposure, they subsume acute exposures. This aspect is discussed below in the evaluations of possible effects.

One of the primary uses of a risk assessment is risk management. Decision makers can use the risk assessment to identify those herbicides, application methods, or exposure rates that pose the greatest risks to workers and the public. Specific mitigation measures can then be employed where the decision maker believes the risks to be unacceptably high. Because the risk assessment is based on a number of assumptions, risk values are not absolute. If assumptions change, the risk values change. However, the relative risk among herbicides or methods would remain valid. Of course, if new toxicity data became available that indicated more adverse response(s) than previous data indicated, the risk assessment would need to be revised.

To facilitate decision making, acceptable risk levels must be established. EPA has established a significant cancer risk level of 1 chance in 1 million; the State of California, through Proposition 65, has established a standard of 1 chance in 1 hundred thousand. The RfD is also an EPA-established measure of acceptable risk for non-carcinogen exposures. This assessment uses the standards of 1 chance in 1 million for cancer risk and the RfD for non-carcinogen exposures.

Hazard Analysis

The hazards associated with using each of the herbicides were determined by a thorough review of available toxicological studies, which are referenced in Appendix D on pages 3 to 28. The reviews are contained in other documents and are referenced here as needed. A considerable body of information has been compiled in a group of risk assessments completed by Syracuse

Environmental Research Associates, Inc. (SERA 2003a, 2003b, 2004a, 2004b, 2005), authored by Dr. Patrick Durkin, PhD, under contract to the Forest Service, the risk assessment contained in the programmatic Region 5 Final EIS Vegetation Management for Reforestation (USDA 1989b), and the risk assessment contained in the Herger-Feinstein Quincy Library Group Forest Recovery Act Final Supplemental EIS (USDA, 2003b). Another source of information on toxicity are the background statements contained in Forest Service Agricultural Handbook No. 633 (USDA 1984). Current peer-reviewed articles from the open scientific literature, as well as recent U. S. EPA documents are also used to update the information contained in these documents. Toxicity information for the surfactants being considered for use are summarized in USDA, 2003a and USDA, 2007a. Additional information on toxicity is contained in Williams, et al (2000). Current peer-reviewed articles from the open scientific literature, as well as recent U.S. EPA documents are also used to update information contained in these documents. All of these documents are incorporated by reference into this risk assessment.

The toxicological database for each herbicide was reviewed for acute, subchronic, and chronic effects on test animals. Because of the obvious limitations on the testing of chemicals on humans, judgments about the potential hazards of pesticides to humans is necessarily based in large part on the results of toxicity tests on laboratory animals. Where such information is available, information on actual human poisoning incidents and effects on human populations supplement these test results. For a background discussion of the various toxicological tests and endpoints, refer to USDA (1989b, pages F-7 to F-18).

Impurities and Metabolites

Virtually no chemical synthesis yields a totally pure product. Technical grade herbicides, as with other technical grade products, undoubtedly contain some impurities. The U. S. EPA defines the term impurity as "…any substance … in a pesticide product other than an active ingredient or inert ingredient, including un-reacted starting materials, side reaction products, contaminants, and degradation products" (40 CFR 158.153(d)). To some extent, concern for impurities in technical grade products is reduced by the fact that the existing toxicity studies on these herbicides were conducted with the technical grade product. Thus, if toxic impurities are present in the technical grade product, they are likely to be encompassed by the available toxicity studies on the technical grade product. An exception to this general rule involves carcinogens, most of which are presumed to act by non-threshold mechanisms. Because of the non-threshold assumption, any amount of a carcinogen in an otherwise non-carcinogenic mixture may pose a carcinogenic risk. As with contaminants, the potential effect of metabolites on a risk assessment is often encompassed by the available *in vivo* toxicity studies under the assumption that the toxicological consequences of metabolism in the species on which toxicity studies are available will be similar to those in the species of concern (humans in this case). Uncertainties in this assumption are encompassed by using an uncertainty factor in deriving the RfD and may sometimes influence the selection of the study used to derive the RfD. Unless otherwise specifically referenced, all data and test results are from the references listed at the herbicide heading.

Inert Ingredients

Issues concerning inert ingredients, additives, and the toxicity of formulations is discussed in USDA 1989b (pages 4-116 to 4-119). The approach used in USDA 1989b, the SERA Risk Assessments, and this site-specific analysis to assess the human health effects of inert ingredients and full formulations has been to: (1) compare acute toxicity data between the formulated products (including inert ingredients) and their active ingredients alone; (2) disclose whether or not the formulated products have undergone chronic toxicity testing; and (3) identify, with the help of EPA and the chemical companies, ingredients of known toxicological concern in the formulated products and assess the risks of those ingredients.

Researchers have studied the relationships between acute and chronic toxicity and while the biological end-points are different, relationships do exist and acute toxicity data can be used to give an indication of overall toxicity (Zeise, et al. 1984). The court in NCAP v. Lyng, 844 F.2d 598 (9th Cir 1988) decided that this method of analysis provided sufficient information for a decisionmaker to make a reasoned decision. In SRCC v. Robertson, Civ.No. S-91-217 (E.D. Cal., June 12, 1992), and again in CATS v. Dombeck, Civ. S-00-2016 (E.D. Cal., Aug 31, 2001), the district court upheld the adequacy of the methodology used in USDA 1989b for disclosure of inert ingredients and additives.

The EPA has categorized approximately 1200 inert ingredients into four lists. Lists 1 and 2 contain inert ingredients of toxicological concern (USDA 1989b, 4-116). List 3 includes substances for which EPA has insufficient information to classify as either hazardous (List 1 and 2) or non-toxic (List 4). List 4 contains non-toxic substances such as corn oil, honey and water. Use of formulations containing inert ingredients on List 3 and 4 is preferred on vegetation management projects under current Forest Service policy.

Since most information about inert ingredients is classified as "Confidential Business Information" the Forest Service asked EPA to review thirteen herbicides for the preparation of USDA 1989b (includes glyphosate, triclopyr, and hexazinone) and the commercial formulations and advise if they contain inert ingredients of toxicological concern (Inerts List 1 or 2)(USDA 1989b, Appendix F, Attachment B). The U.S. EPA determined that there were no inerts on List 1 or 2, with the exception of kerosene in certain formulations triclopyr. Kerosene has since been moved to List 3. In addition, the CBI files were reviewed in the development of most of the SERA risk assessments. Information has also been received from the companies who produce the herbicides and spray additives.

Butoxyethanol (or EGBE) has been assessed for human health risk as an impurity in the Garlon 4 formulation of triclopyr (Borrecco and Neisess 1991). In that risk assessment, the addition of butoxyethanol did not substantially increase the risk to human health over the risk of using the active ingredient of triclopyr. The amount of butoxyethanol in Garlon 4 is listed as 0.3% in that assessment.

Comparison of acute toxicity (LD_{50} (lethal dose) values) data between the formulated products (including inert ingredients) and their active ingredients alone shows that the formulated products are generally less toxic than their active ingredients (USDA 1989b, USDA 1984, SERA risk assessments).

While these formulated products have not undergone chronic toxicity testing like their active ingredients, the acute toxicity comparisons, the EPA review, and our examination of toxicity information on the inert ingredients in each product leads us to conclude that the inert ingredients in these formulations do not significantly increase the risk to human health and safety over the risks identified for the active ingredients.

Environmental Consequences

Worker Exposure Analysis

Pesticide applicators are the individuals most likely to be exposed to a pesticide during application. Two types of worker exposure assessments are considered: general and accidental/incidental. The term general exposure assessment is used to designate those exposures that involve estimates of absorbed dose based on the handling of a specified amount of a chemical during specific types of applications. The accidental/incidental exposure scenarios involve specific types of events that could occur during any type of application.

In past risk assessments for the USDA Forest Service, exposure rates were by the estimated dermal absorption rate, typically using 2,4-D as a surrogate chemical when compound-specific data were not available (USDA 1989b). In 1998, SERA conducted a detailed review and re-evaluation of the available worker exposure studies that can be used to relate absorbed dose to the amount of chemical handled per day (SERA 1998). This review noted that there was no empirical support for a dermal absorption rate correction. Two factors appear to be involved in this unexpected lack of association: 1) algorithms for estimating dermal absorption rates have large margins of error; and, 2) actual levels of worker exposure are likely to be far more dependent on individual work practices or other unidentified factors than on differences in dermal absorption rates.

Thus, in the absence of data to suggest an alternative approach, no corrections for differences in dermal absorption rate coefficients or other indices of dermal absorption seem to be appropriate for adjusting occupational exposure rates. Although pesticide application involves many different job activities, exposure rates can be defined for three categories: directed foliar applications (including cut surface, streamline, and direct sprays) involving the use of backpacks or similar devices, broadcast hydraulic spray applications, and broadcast aerial applications. While these may be viewed as crude groupings, the variability in the available data does not seem to justify further segmenting the job classifications - e.g., hack-and-squirt, injection bar.

General Exposures - As described in SERA (2007), worker exposure rates are expressed in units of milligrams (mg) of absorbed dose per kilogram (kg) of body weight per pound of chemical handled (mg/kg/lb applied). The exposure rates used in this risk assessment are based on worker exposure studies on nine different pesticides with molecular weights ranging from 169 to 416 and the base-10 log of the octanol water coefficient (log K_{ow}) values at pH 7 ranging from –2.90 to 6.50 (SERA 1998, Table 1). The estimated exposure rates (Table 3-16) are based on estimated absorbed doses in workers as well as the amounts of the chemical handled by the workers (SERA 1998, Table 5). Exposure rates are shown as milligrams of chemical per kilogram of body weight per pound of active ingredient (ai) applied. The molecular weight and log K_{ow} of the five herbicides considered in this risk assessment are within the range of pesticides studied in SERA (1998). Although the molecular weight of NP9E is outside this range, the values derived in SERA (1998b), should be conservative for this use, because larger molecules would tend to be absorbed at lower rates. As described in SERA (2007), the ranges of estimated occupational exposure rates vary substantially among individuals and groups, (i.e., by a factor of 50 for backpack applicators). It seems that much of the variability can be attributed to the hygienic measures taken by individual workers (i.e., how careful the workers are to avoid unnecessary exposures).

Table 3-16. Estimated Exposure Rates from Herbicides Proposed on the Freds Fire

Job Category	Typical (mg/kg/lb ai)	Lower (mg/kg/lb ai)	Upper (mg/kg/lb ai)
Ground Application	0.003	0.0003	0.01

Source: SERA 1998, Table 5.

The estimated number of acres treated per hour is taken from recent experiences (1991-2004) on the ENF. Experience on the ENF for work similar to what is proposed indicates typical production rates of 2.0 acres per day per worker for backpack application. Crew sizes are expected to range from 8 to 12 workers when applying these herbicides. The number of hours worked per day is expressed as a range, 6-8 hours per day in activities that actually involve herbicide exposure.

The range of acres treated per hour and hours worked per day is used to calculate a range for the number of acres treated per day. For this calculation as well as others in this section involving the multiplication of ranges, the lower end of the resulting range is the product of the lower end of one range and the lower end of the other range. Similarly, the upper end of the resulting range is the product of the upper end of one range and the upper end of the other range. This approach is taken to encompass as broadly as possible the range of potential exposures. The central estimate of the acres treated per day is taken as the arithmetic average of the range. Because of the relatively narrow limits of the ranges for backpack spray workers, the use of the arithmetic mean rather than some other measure of central tendency, like the geometric mean, has no marked effect on the risk assessment.

The application rates are based on the planned application rates for each of these herbicides under the proposed action (Alternative 1) and are based on previous experience using these herbicides on the ENF (refer to Table 3-17). Rates are expressed as either acid equivalents (ae) or active ingredient (ai). Similarly, the application rates are based on ENF experience. The typical application rate is 20-25 gallons per acre of herbicide mixture applied, with the lowest dilution being 10 gallons per acre, and the highest being 30 gallons per acre. For hexachlorobenzene, the application rate is based on the application rate for clopyralid and the percentage of hexachlorobenzene in clopyralid.

Table 3-17. Herbicide and Nonylphenol Polyethoxylate Application Rates to be used on the Freds Fire (Including the Incidental Rate of Application of the Impurity Hexachlorobenzene in Clopyralid)

Herbicide	Application Rate Typical (lb/ac)	Application Rate Lowest (lb/ac)	Application Rate Highest (lb/ac)
Chlorsulfuron	0.14 ai	0.047 ai	0.14 ai
Clopyralid	0.25 ae	0.10 ae	0.25 ae
Glyphosate	3.2 ae	2.7 ae	4.8 ae
Hexazinone	3.0 ae	2.0 ae	3.0 ae
Triclopyr (BEE)	2.0 ae	1.6 ae	2.4 ae
Nonylphenol polyethoxylate	1.3 ai	1.1 ai	2.0 ai
Hexachlorobenzene	0.000000625 ai	0.00000025 ai	0.000000625 ai

Accidental Exposures - Typical occupational exposures may involve multiple routes of exposure (i.e., oral, dermal, and inhalation); nonetheless, dermal exposure is generally the predominant route for herbicide applicators. Typical multi-route exposures are encompassed by the methods used on general exposures. Accidental exposures, on the other hand, are most likely to involve splashing a solution of herbicides into the eyes or to involve various dermal exposure scenarios.

The available literature does not include quantitative methods for characterizing exposure or responses associated with splashing a solution of a chemical into the eyes; furthermore, there appear to be no reasonable approaches to modeling this type of exposure scenario quantitatively. Consequently, accidental exposure scenarios of this type are considered qualitatively in the risk characterization.

There are various methods for estimating absorbed doses associated with accidental dermal exposure. Two general types of exposure are modeled: those involving direct contact with a solution of the herbicide and those associated with accidental spills of the herbicide onto the surface of the skin. Any number of specific exposure scenarios could be developed for direct contact or accidental spills by varying the amount or concentration of the chemical on or in contact with the surface of the skin and by varying the surface area of the skin that is contaminated.

For this risk assessment, two exposure scenarios are developed for each of the two types of dermal exposure, and the estimated absorbed dose for each scenario is expressed in units of mg chemical/kg body weight.

Exposure scenarios involving direct contact with solutions of the chemical are characterized by immersion of the hands for 1 minute or wearing contaminated gloves for 1 hour. Generally, it is not reasonable to assume or postulate that the hands or any other part of a worker will be immersed in a solution of an herbicide for any period of time. On the other hand, contamination of gloves or other clothing is quite plausible. For these exposure scenarios, the key element is the assumption that wearing gloves grossly contaminated with a chemical solution is equivalent to immersing the hands in a solution. In either case, the concentration of the chemical in solution that is in contact with the surface of the skin and the resulting dermal absorption rate are essentially constant. Exposure scenarios involving chemical spills on to the skin are characterized by a spill on to the lower legs as well as a spill on to the hands. In these scenarios, it is assumed that a solution of the chemical is spilled on to a given surface area of skin and that a certain amount of the chemical adheres to the skin.

Summaries of the worker exposure scenarios for both general and accidental exposure for each herbicide (including NPE and hexachlorobenzene) are shown in Appendix D.

Public Exposure Analysis

Under normal conditions, members of the general public should not be exposed to substantial levels of any of these herbicides. Nonetheless, any number of exposure scenarios can be constructed for the general public, depending on various assumptions regarding application rates, dispersion, canopy interception, and human activity. Several highly conservative scenarios are developed for this risk assessment.

There are permanent residences or second homes within a ¼ mile of some of the proposed treatment areas, containing an estimated 250 residents. These residences are located along the South Fork of the American River. All other treatment areas are greater than ¼ mile from permanent human habitation. Any exposure from an herbicide spray project, due to drift, to residents living beyond ¼ mile from treatment sites would be negligible (USDA 1989b, pages F-79 to F-81). According to recent work completed by the Department of Pesticide Regulation (DPR), exposure to native plant material collectors can be essentially eliminated if they remain at least 100 feet from the treated areas (Goh, K., as referenced in Bakke, 2000). In DPR’s study (Segawa et al, 2001), herbicides were detected in 19 of 227 (8%) samples taken outside both aerial and ground-based herbicide application units, the majority of these positive samples (90%) were within 70 feet of the sampled unit edge, and all positive samples had concentrations of herbicides less than or equal to 2.68 parts per million. This study did not determine whether these detected amounts were due to drift or errors in application. This would indicate that with ground-based applications, negligible amounts of off-site movement due to drift would be expected beyond 75 to 100 feet from the unit edge.

The proposed units are near or within parts of the ENF used for dispersed recreation, which might include activities such as hiking, hunting, fishing, woodcutting, berry-picking, or collection of plant materials for basket weaving. The public generally will pass through or near these units while participating in these activities. This dispersed use is estimated to be around 10-30 people per year on any given unit. Assuming each of the units could have people in them at the same time would represent 400 to 1,200 people per year.

The two types of exposure scenarios developed for the general public includes acute exposure and longer-term, or chronic, exposure. All of the acute exposure scenarios are primarily accidental. They assume that an individual is exposed to the compound either during or shortly after its application. Specific scenarios are developed for direct spray, dermal contact with contaminated vegetation, as well as the consumption of contaminated fruit, vegetation, water, and fish. Most of these scenarios should be regarded as extreme, some to the point of limited plausibility. The longer-term, or chronic exposure scenarios parallel the acute exposure scenarios for the consumption of contaminated fruit, vegetation, water, and fish but are based on estimated levels of exposure for longer periods after application. A summary of the general public exposure scenarios can be found in Appendix D.

Direct Spray

For direct spray scenarios, it is assumed that during a ground application, a naked child is sprayed directly with the herbicide. The scenario also assumes that the child is completely covered (that is, 100% of the surface area of the body is exposed), which makes this an extremely conservative exposure scenario that is likely to represent the upper limits of plausible exposure. An additional set of scenarios are included involving a young woman who is accidentally sprayed over the feet and legs. For each of these scenarios, some standard assumptions are made regarding the surface area of the skin and body weight.

For the scenario for dermal exposure from contaminated vegetation, it is assumed that the herbicide is sprayed at a given application rate and that an individual comes in contact with sprayed vegetation or other contaminated surfaces at some period after the spray operation. For these exposure scenarios, some estimates of dislodgeable residue and the rate of transfer from the contaminated vegetation to the surface of the skin must be available. No such data are directly available for these herbicides, so estimation methods are used.

Contaminated Water

Water can be contaminated from runoff, as a result of leaching from contaminated soil, from a direct spill, or from unintentional contamination from applications. For this risk assessment, two types of estimates made for the concentration of these herbicides in ambient water are considered: (1) acute/accidental exposure from an accidental spill and (2) longer-term exposure to the herbicides in ambient water that could be associated with the typical application of this compound to a 100-acre treatment area.

Two exposure scenarios were considered. The first assumes that a young child (2- to 3-years old) consumes contaminated water shortly after an accidental spill of a field solution into a small pond. Because this scenario is based on the assumption that exposure occurs shortly after the spill, no dissipation or degradation of the herbicide is considered. This is an extremely conservative scenario dominated by arbitrary variability. It is unlikely that ponds would be the waterbody receiving any herbicides in this project. Since flowing streams are the more likely recipients, a second scenario was developed in which a stream is contaminated through drift, runoff, or percolation and a child consumes water from that stream. For the level of herbicide in this stream, an assumption of the short-term water contamination rate was developed (Table 3-18a)

Water monitoring results following herbicide applications in Region 5 (USDA, 2001a) were used to estimate concentrations of glyphosate, hexazinone, and triclopyr in water. For hexazinone, the lower, central, and upper estimates are based on the 50th, 90th, and 99th percentile results from Region 5 monitoring. For triclopyr the lower estimate is taken as zero (no detect) and the central estimate is taken as 3 ppb, which is rounded up from the highest detection in non-accidental or erroneous applications. For glyphosate the lower estimate is taken as zero. The SERA estimate was used for the upper estimate of triclopyr, and the central and upper estimate for glyphosate. For the other chemicals concentrations of these herbicides in water used levels derived from the SERA Risk Assessments.

The scenario for chronic exposure to these herbicides from contaminated water assumes that an adult consumes contaminated ambient water for a lifetime. There are some monitoring studies available on many of these herbicides that allow for an estimation of expected concentrations in ambient water associated with ground applications of the compound over a wide area (glyphosate, hexazinone, and triclopyr). For the others, such monitoring data does not exist. For those herbicides without monitoring data, for this component of the exposure assessment, estimates of levels in ambient water were made based on the *Groundwater Loading Effects of Agricultural Management Systems* (GLEAMS) model. GLEAMS is a root zone model that can be used to examine the fate of chemicals in various types of soils under different meteorological and hydro-geological conditions. The specific estimates of longer-term concentrations of these herbicides in water that are used in this risk assessment are summarized in Table 3-18b.

It is important to note that water monitoring conducted in the Pacific Southwest Region since 1991, involving glyphosate, triclopyr, and hexazinone has not shown levels of water contamination as high as these for normal (i.e., not accidental) applications (USDA, 2001a). This indicates that, at least for these herbicides, the assumptions in this risk assessment provide for a conservative (i.e. protective) assessment of risk. In addition, water monitoring involving clopyralid and hexachlorobenzene conducted on the ENF between 2002 and 2006 have not shown levels of water contamination as high as these for normal (i.e., not accidental) applications (USDA 2003c, 2006). Based on these samples, the assumptions in this risk assessment provide for a conservative (i.e. protective) assessment of risk for these two chemicals.

Table 3-18a. Short-Term Water Contamination Rates (WCR) of Herbicides, Nonylphenol Polyethoxylate, and the Hexachlorobenzene Impurity (in mg/L per lb applied)

Herbicide	Typical WCR	Low WCR	High WCR
Chlorsulfuron	0.1	0.01	0.2
Clopyralid	0.02	0.005	0.07
Glyphosate	0.02	0.0	0.4
Hexazinone	0.005	0.003	0.1
Triclopyr	0.003	0.0	0.4
Nonylphenol Polyethoxylate	0.012	0.0031	0.031
Hexachlorobenzene	0.09	0.001	0.3

Table 3-18b. Longer-Term Water Contamination Rates (WCR) of Herbicides, Nonylphenol Polyethoxylate, and the Hexachlorobenzene Impurity (in mg/L per lb applied)

Herbicide	Typical WCR	Low WCR	High WCR
Chlorsulfuron	0.0006	0.0001	0.0009
Clopyralid	0.007	0.001	0.013
Glyphosate	0.001	0.0001	0.008
Hexazinone	0.02	0.00001	0.07
Triclopyr	0.03	0.008	0.05
Nonylphenol Polyethoxylate	0.007	0.0	0.014
Hexachlorobenzene	0.0005	0.00003	0.001

Many chemicals may be concentrated or partitioned from water into the tissues of animals or plants in the water. This process is referred to as bio-concentration. Generally, bio-concentration is measured as the ratio of the concentration in the organism to the concentration in the water. For example, if the concentration in the organism is 5 mg/kg and the concentration in the water is 1 mg/L, the bio-concentration factor (BCF) is 5 L/kg. As with most absorption processes, bio-concentration depends initially on the duration of exposure but eventually reaches steady state. Most of the herbicides in this risk assessment have BCF values for fish of 1 or less. There are three with BCF values greater than 1: hexazinone (1-2), chlorsulfuron (1-12), and hexachlorobenzene (10,000).

For both the acute and longer-term exposure scenarios involving the consumption of contaminated fish, the water concentrations of the herbicides used are identical to the concentrations used in the contaminated water scenarios. The acute exposure scenario is based on the assumption that an adult angler consumes fish taken from contaminated water shortly after an accidental spill into a pond. No dissipation or degradation is considered. Because of the available and well-documented information and substantial differences in the amount of caught fish consumed by the general public and Native American subsistence populations, separate exposure estimates are made for these two groups. The chronic exposure scenario is constructed in a similar way.

Contaminated Vegetation

Under normal circumstances and in most types of applications, it is extremely unlikely that humans will consume, or otherwise place in their mouths, vegetation contaminated with these herbicides. Nonetheless, any number of scenarios could be developed involving either accidental spraying of crops, the spraying of edible wild vegetation, like berries, or the spraying of plants collected by Native Americans for basketweaving or medicinal use. These scenarios assume that vegetation is directly sprayed and that no washing of vegetation occurs. In most instances and particularly for longer-term scenarios, treated vegetation would probably show signs of damage from herbicide exposure, thereby reducing the likelihood of consumption that would lead to significant levels of human exposure. Notwithstanding that assertion, it is conceivable that individuals could consume contaminated vegetation.

Two sets of exposure scenarios are provided: one for the consumption of contaminated fruit and the other for the consumption of contaminated vegetation. One of the more plausible scenarios involves the consumption of contaminated berries after treatment along a road or some other area in which wild berries grow. A second scenario is the consumption of contaminated vegetation after treatment. The two accidental exposure scenarios developed for each exposure assessment include one scenario for acute exposure and one scenario for longer-term exposure. In these scenarios, the concentration of herbicide on contaminated vegetation is estimated using an empirical relationship between application rate and concentration on vegetation.

Summaries of the public exposure scenarios for each herbicide (including NPE and hexachlorobenzene) are shown in Appendix D.

Dose-Response Assessment

In evaluating the doses received under each scenario, the doses are evaluated against RfDs, as previously discussed. If all the exposures are less than the RfDs (HQ less than or equal to 1) the assumption is that the herbicide presents very little risk of use to either the public or workers. If any exposure exceeds the RfD, a closer examination of the various studies and exposure scenarios must be made to determine whether a toxic response is expected from the exposure. The risk assessment (Appendix D) describes the RfDs and their basis. For those scenarios that involve doses exceeding RfDs, it provides an analysis of various studies and further refines the risk thresholds. Table 3-19 displays the acute and chronic RfDs used in the risk assessment.

Table 3-19. Reference Doses (RfD) of Herbicides (including Nonylphenol Polyethoxylate and Hexachlorobenzene)

Herbicide	Reference Dose (mg/kg/day)	
	Acute	Chronic
Chlorsulfuron	0.25	0.02
Clopyralid	0.75	0.15
Glyphosate	2.0	2.0
Hexazinone	4.0	0.05
Triclopyr	1.0	0.05
Nonylphenol Polyethoxylate	0.1	0.1
Hexachlorobenzene	0.008[1]	0.0008

[1] Acute Minimal Risk Level (MRL)

Risk Characterization

A quantitative summary and narrative description of risks to workers and the public from herbicide exposure is presented in the section. The quantitative risk characterization is expressed as the hazard quotient, which is the ratio of the estimated exposure doses to the RfD. Tables 3-20a-1 through 3-20g-4 provide a summary of risk characterization for workers and the general public.

The only reservation attached to this assessment is that associated with any risk assessment: Absolute safety cannot be proven and the absence of risk can never be demonstrated. No chemical has been studied for all possible effects and the use of data from laboratory animals to estimate hazard or the lack of hazard to humans is a process that contains uncertainty. Prudence dictates that normal and reasonable care should be taken in the handling of these herbicides.

Chlorsulfuron

Workers -Given the very low hazard quotients for both general occupational exposures as well as accidental exposures, the risk characterization for workers is unambiguous. None of the exposure scenarios approach a level of concern.

While the accidental exposure scenarios are not the most severe one might imagine, they are representative of reasonable accidental exposures. Given that the highest hazard quotient for any of the accidental exposures is a factor of about 5,000 below the level of concern, more severe and less plausible scenarios would be required to suggest a potential for systemic toxic effects.

The hazard quotients for general occupational exposure scenarios are somewhat higher than those for the accidental exposure scenarios. Nonetheless, the upper limit of the hazard quotients (HQ=0.2) is below the level of concern **-** i.e., a hazard quotient of 1. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially. The simple verbal interpretation of this quantitative characterization of risk is that even under the most conservative set of exposure assumptions, workers would not be exposed to levels of chlorsulfuron that are regarded as unacceptable. Under typical application conditions, levels of exposure will be far below levels of concern.

Mild irritation to the skin and eyes can result from exposure to relatively high levels of chlorsulfuron- i.e., placement of chlorsulfuron directly onto the eye or skin. From a practical perspective, eye or skin irritation is likely to be the only overt effect as a consequence of mishandling chlorsulfuron. These effects can be minimized or avoided by prudent industrial hygiene practices during the handling of the compound.

General Public –None of the acute scenarios exceed a level of concern. The consumption of contaminated vegetation has a hazard quotient of 0.8, at the upper level. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially.

The longer-term consumption of contaminated vegetation after application of the highest dose yields a hazard quotient that is greater than unity (HQ= 4) at the highest dose. At typical and lower levels of exposure, this scenario yields hazard quotients below a level of concern. This scenario may be extremely conservative in that it does not consider the limited projected use of this herbicide on this project or the likelihood that such treated vegetation in older treated areas are expected to be dead, dying, chlorotic, brittle or deformed and hence undesirable to consume in the long-term.

Table 3-20a-1. Summary of Risk Characterization for Workers – Chlorsulfuron

Chronic RfD = 0.02 mg/kg/day Acute RfD = 0.25 mg/kg/day			
Scenario	Hazard Quotient[1]		
	Typical	Lower	Upper
General Exposures			
Backpack Application	0.04	8E-04	0.2
Accidental/Incidental Exposures			
Immersion of Hands - 1 Minute	1E-06[2]	2E-07	3E-06
Contaminated Gloves - 1 Hour	6E-05	1E-05	2E-04
Spill on Hands - 1 Hour	4E-05	4E-06	2E-04
Spill on Lower Legs - 1 Hour	1E-04	9E-06	5E-04

[1] Hazard quotient is the level of exposure divided by the RfD, then rounded to one significant digit.

[2]As a standard for formatting, numbers greater than 1.0 are expressed in standard decimal notation and smaller numbers are expressed in scientific notations - e.g., 7 E-7 equivalent to 7×10^{-7} or 0.0000007.

Table 3-20a-2. Summary of Risk Characterization for the Public – Chlorsulfuron

Chronic RfD = 0.02 mg/kg/day Acute RfD = 0.25 mg/kg/day			
Scenario	Hazard Quotient		
	Typical	Lower	Upper
Acute/Accidental Exposures			
Direct Spray, Entire Body, Child	1E-03	1E-04	7E-03
Direct Spray, Lower Legs, Woman	1E-04	1E-05	7E-04
Dermal Exposure, Contaminated Vegetation	2E-04	1E-05	1E-03
Contaminated Fruit	7E-03	2E-03	0.1
Contaminated Vegetation	0.09	6E-03	0.8
Contaminated Water, Spill	0.1	0.04	0.2
Contaminated Water, Stream	4E-03	9E-05	0.01
Consumption of Fish, General Public	4E-03	2E-03	4E-03
Consumption of Fish, Subsistence Populations	0.02	9E-03	2E-03
Chronic/Longer Term Exposures			
Contaminated Fruit	0.03	0.01	0.5
Contaminated Vegetation	0.5	0.03	**4**
Consumption of Water	1E-04	5E-06	2E-04
Consumption of Fish, General Public	9E-07	5E-08	1E-06
Consumption of Fish, Subsistence Population	7E-06	4E-07	1E-05

Clopyralid

Workers - Given the very low hazard quotients for both general occupational exposures as well as accidental exposures, the risk characterization for workers is unambiguous; none of the exposure scenarios approaches a level of concern.

While the accidental exposure scenarios are not the most severe one might imagine, they are representative of reasonable accidental exposures. Given that the highest hazard quotient for any of the accidental exposures is a factor of about 1,000 below the level of concern, more severe and less plausible scenarios would be required to suggest a potential for systemic toxic effects. The hazard quotients for general occupational exposure scenarios are somewhat higher than those for the accidental exposure scenarios. Nonetheless, the upper limit of the hazard quotients for backpack application is below the level of concern - i.e., a hazard index of 1. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially. The simple verbal interpretation of this quantitative characterization of risk is that even under the most conservative set of exposure assumptions, workers would not be exposed to levels of clopyralid that are regarded as unacceptable. Under typical application conditions, levels of exposure will be far below levels of concern.

Irritation and damage to the skin and eyes can result from exposure to relatively high levels of clopyralid - i.e., placement of clopyralid directly onto the eye or skin. From a practical perspective, eye or skin irritation is likely to be the only overt effect as a consequence of mishandling clopyralid. These effects can be minimized or avoided by prudent industrial hygiene practices during the handling of clopyralid.

General Public –For the acute/accidental scenarios, the exposure resulting from the consumption of contaminated vegetation is the scenario with the highest hazard quotient (HQ = 0.5) at the upper level. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially.

For the other acute/accidental scenarios, the exposure resulting from the consumption of contaminated water by a child is the scenario with the highest hazard quotient (HQ = 0.1), a factor of 10 below a level of concern. It must be noted that the exposure scenario for the consumption of contaminated water is an arbitrary scenario: scenarios that are more or less severe, all of which may be equally probable or improbable, easily could be constructed. All of the specific assumptions used to develop this scenario have a simple linear relationship to the resulting hazard quotient. Thus, if the accidental spill were to involve 20 rather than 200 gallons of a field solution of clopyralid, all of the hazard quotients would be a factor of 10 less. Nonetheless, this and other acute scenarios help to identify the types of scenarios that are of greatest concern and may warrant the greatest steps to mitigate. For clopyralid, such scenarios involve oral (contaminated water) rather than dermal (spills or accidental spray) exposure.

For chronic scenarios, the consumption of contaminated vegetation has a hazard quotient slightly above unity (HQ = 1.2). At typical and lower levels of exposure, this scenario yields hazard quotients below a level of concern. As previously described, this scenario may be extremely conservative in that it does not consider the limited projected use of this herbicide on this project or the likelihood that such treated vegetation in older treated areas are expected to be dead, dying, chlorotic, brittle or deformed and hence undesirable to consume in the long-term. However, this scenario points out the importance of directing the herbicide onto the targeted vegetation and avoiding non-target deposition through overspray.

Table 3-20b-1. Summary of Risk Characterization for Workers – Clopyralid

Chronic RfD = 0.15 mg/kg/day Acute RfD = 0.75 mg/kg/day			
Scenario	Hazard Quotient		
	Typical	Lower	Upper
General Exposures			
Backpack Application	0.01	2E-04	0.05
Accidental/Incidental Exposures			
Immersion of Hands - 1 Minute	5E-07	1E-07	2E-06
Contaminated Gloves - 1 Hour	3E-05	8E-06	1E-04
Spill on Hands - 1 Hour	1E-04	2E-05	5E-04
Spill on Lower Legs - 1 Hour	2E-04	5E-05	1E-03

[1] Hazard quotient is the level of exposure divided by the RfD, then rounded to one significant digit.

Table 3-20b-2. Summary of Risk Characterization for the Public – Clopyralid

Chronic RfD = 0.15 mg/kg/day Acute RfD = 0.75 mg/kg/day			
Scenario	Hazard Quotient		
	Typical	Lower	Upper
Acute/Accidental Exposures			
Direct Spray, Entire Body, Child	4E-03	8E-04	0.02
Direct Spray, Lower Legs, Woman	4E-04	8E-05	2E-03
Dermal Exposure, Contaminated Vegetation	5E-04	4E-05	2E-03
Contaminated Fruit	4E-03	2E-03	0.06
Contaminated Vegetation	0.05	5E-03	0.5
Contaminated Water, Spill	0.09	0.06	0.1
Contaminated Water, Stream	5E-04	3E-05	3E-03
Consumption of Fish, General Public	3E-03	3E-03	3E-03
Consumption of Fish, Subsistence Populations	0.01	0.01	0.01
Chronic/Longer Term Exposures			
Contaminated Fruit	8E-03	3E-03	0.2
Contaminated Vegetation	0.1	7E-03	**1.2**
Consumption of Water	3E-04	1E-05	7E-04
Consumption of Fish, General Public	2E-06	1E-07	3E-06
Consumption of Fish, Subsistence Population	1E-05	8E-07	3E-05

Glyphosate

Workers - Given the low hazard quotients for both general occupational exposures as well as accidental exposures, the risk characterization for workers is unambiguous. None of the exposure scenarios exceed a level of concern.

While the accidental exposure scenarios are not the most severe one might imagine, they are representative of reasonable accidental exposures. Given that the highest hazard quotient for any of the accidental exposures is a factor of about 500 below the level of concern, more severe and less plausible scenarios would be required to suggest a potential for systemic toxic effects. The hazard quotients for these acute occupational exposures are based on a chronic RfD. This adds an additional level of conservatism and, given the very low hazard quotients for these scenarios, reinforces the conclusion that there is no basis for asserting that systemic toxic effects are plausible.

The hazard quotients for general occupational exposure scenarios are somewhat higher than those for the accidental exposure scenarios. Nonetheless, the upper limits of the hazard quotients are below the level of concern **-** i.e., a hazard index of 1. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially. The simple verbal interpretation of this quantitative characterization of risk is that even under the most conservative set of exposure assumptions, workers would not be exposed to levels of glyphosate that are regarded as unacceptable. Under typical backpack application conditions, levels of exposure will be at least 100 times below the level of concern.

Glyphosate and glyphosate formulations are skin and eye irritants. Quantitative risk assessments for irritation are not normally derived, and, for glyphosate specifically, there is no indication that such a derivation is warranted.

General Public - For chronic scenarios, the consumption of contaminated vegetation has a hazard quotient above unity (HQ = 1.8) at the upper level. At typical and lower levels of exposure, this scenario yields hazard quotients below a level of concern. As previously described, this scenario may be extremely conservative in that it does not consider the likelihood that such treated vegetation in older treated areas are expected to be dead, dying, chlorotic, brittle or deformed and hence undesirable to consume in the long-term. However, this scenario points out the importance of directing the herbicide onto the targeted vegetation and avoiding non-target deposition through overspray. While this is an unacceptable level of exposure, it is far below doses that would likely result in overt signs of toxicity. As detailed in SERA (2003a), a dose of 184 mg/kg as Roundup – i.e., glyphosate plus surfactant – was not associated with any overt signs of toxicity in humans – and mild signs of toxicity were apparent at doses of 427 mg/kg, over 100 times higher than the dose associated with this scenario (3.55 mg/kg).

None of the other longer-term exposure scenarios approach a level of concern. Although there are several uncertainties in the longer-term exposure assessments for the general public, the upper limits for hazard quotients are sufficiently far below a level of concern that the risk characterization is relatively unambiguous: based on the available information and under the foreseeable conditions of application, there is no route of exposure or scenario suggesting that the general public will be at any substantial risk from longer-term exposure to glyphosate.

For the acute/accidental scenarios, the exposure resulting from the consumption of contaminated vegetation is the scenario with the highest hazard quotient (HQ = 3) at the upper level. At typical and lower levels of exposure, this scenario yields hazard quotients below a level of concern. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially. As described above, while this is an unacceptable level of exposure, it is far below doses that would likely result in overt signs of toxicity, and is over 50 times lower than doses where mild signs of toxicity were apparent (427 mg/kg).

For the other acute/accidental scenarios, the exposure resulting from the consumption of contaminated water by a child, at the highest application rates, approaches the level of concern. At the exposure level for a child drinking water, as per the discussion in Section 4, no effects would be anticipated for doses up to 20 mg/kg/day. It is important to realize that the exposure scenarios involving contaminated water are arbitrary scenarios: scenarios that are more or less severe, all of which may be equally probable or improbable, easily could be constructed. All of the specific assumptions used to develop this scenario have a simple linear relationship to the resulting hazard quotient. Thus, if the accidental spill were to involve 20 rather than 200 gallons of a field solution of glyphosate, all of the hazard quotients would be a factor of 10 less. A further conservative aspect to the water contamination scenario is that it represents standing water, with no dilution or decomposition of the herbicide. This is unlikely in a forested situation where flowing streams are more likely to be contaminated in a spill, rather than a standing pond of water. The contaminated stream scenario presents a more realistic scenario for potential operational contamination of a stream; the HQ values are substantially below 1. Nonetheless, this and other acute scenarios help to identify the types of scenarios that are of greatest concern and may warrant the greatest steps to mitigate. For glyphosate, such scenarios involve oral (contaminated water) rather than dermal (spills or accidental spray) exposure.

Table 3-20c-1. Summary of Risk Characterization for Workers – Glyphosate

RfD = 2.0 mg/kg/day			
Scenario	Hazard Quotient		
	Typical	Lower	Upper
General Exposures			
Backpack Application	0.01	5E-04	0.07
Accidental/Incidental Exposures			
Immersion of Hands - 1 Minute	3E-06	6E-07	1E-05
Contaminated Gloves - 1 Hour	2E-04	4E-05	7E-04
Spill on Hands - 1 Hour	4E-04	1E-04	9E-04
Spill on Lower Legs - 1 Hour	9E-04	2E-04	2E-03

Table 3-20c-2. Summary of Risk Characterization for the Public – Glyphosate

RfD = 2.0 mg/kg/day	
Scenario	

of exposure. These effects did not persist after exposure was terminated. It is important to recognize that the product applied in this study was recognized as defective, with excessive dustiness. As a result of this study, the USFS, Region 5 established additional requirements for protective equipment when applying granular hexazinone formulations via belly grinder. In addition, this direction instructs applicators not to continue applications if excessive dustiness is seen.

While skin irritation could also occur, it would probably be less severe than effects on the eyes.

General Public - For the acute/accidental scenarios, none exceed a level of concern. The consumption of contaminated water after a spill by a child or by consuming fish found in such contaminated waters, at the upper dose estimates equals the level of concern (HQ=1). The exposure scenarios involving contaminated water are arbitrary scenarios: scenarios that are more or less severe, all of which may be equally probable or improbable, easily could be constructed. All of the specific assumptions used to develop this scenario have a simple linear relationship to the resulting hazard quotient. Thus, if the accidental spill were to involve 20 rather than 200 gallons of a field solution of hexazinone, all of the hazard quotients would be a factor of 10 less. A further conservative aspect to the water contamination scenario is that it represents standing water, with no dilution or decomposition of the herbicide. This is unlikely in a forested situation where flowing streams are more likely to be contaminated in a spill, rather than a standing pond of water. The contaminated stream scenario presents a more realistic scenario for potential operational contamination of a stream; the HQ values are well below 1 (HQ = 0.008). The greatest practical consequence of a direct spray probably would be eye irritation, which could be severe

Of the longer-term scenarios, the consumption of unwashed vegetation after application of the highest dose yields a hazard quotient of 1.4. This scenario may be extremely conservative in that it does not consider the effects of washing contaminated vegetation or the likelihood that such treated vegetation in older treated areas are expected to be dead, dying, chlorotic, brittle or deformed and hence undesirable to consume in the long-term.

Table 3-20d-1. Summary of Risk Characterization for Workers – Hexazinone

Chronic RfD = 0.05 mg/kg/day Acute RfD = 4.0 mg/kg/day			
Scenario	Hazard Quotient		
	Typical	Lower	Upper
General Exposures			
Backpack Application	0.4	0.01	1.8
Accidental/Incidental Exposures			
Immersion of Hands - 1 Minute	6E-04	4E-04	1E-03
Contaminated Gloves - 1 Hour	0.04	0.02	0.06
Spill on Hands - 1 Hour	Not applicable to granular formulations		
Spill on Lower Legs - 1 Hour	Not applicable to granular formulations		

Table 3-20d-2. Summary of Risk Characterization for the Public – Hexazinone

Chronic RfD = 0.05 mg/kg/day Acute RfD = 4.0 mg/kg/day			
Scenario	Hazard Quotient		
	Typical	Lower	Upper
Acute/Accidental Exposures			
Direct Spray, Entire Body, Child	Not applicable to granular formulations		
Direct Spray, Lower Legs, Woman	Not applicable to granular formulations		
Dermal Exposure, Contaminated Vegetation	1E-04	4E-05	3E-04
Contaminated Fruit	4E-04	2E-04	6E-03
Contaminated Vegetation	5E-03	2E-03	0.04
Contaminated Water, Spill	0.3	0.08	**1.0**
Contaminated Water, Stream	3E-04	7E-05	8E-03
Consumption of Fish, General Public	0.01	4E-03	0.02
Consumption of Fish, Subsistence Populations	0.05	0.02	0.1
Chronic/Longer Term Exposures			
Contaminated Fruit	0.01	8E-03	0.2
Contaminated Vegetation	0.2	0.07	**1.4**
Consumption of Water	0.03	8E-06	0.1
Consumption of Fish, General Public	4E-04	1E-07	1E-03
Consumption of Fish, Subsistence Population	3E-03	1E-06	0.01

Triclopyr

Workers – The toxicity data on triclopyr allows for separate dose-response assessments for acute and chronic exposures. For acute exposures, the hazard quotients are based on an acute NOAEL (no observed adverse effects level) of 100 mg/kg/day from a gestational study in rats resulting in a provisional acute RfD of 1 mg/kg/day. For women of childbearing age, the acute RfD is based on the reproductive study resulting in the NOAEL of 5 mg/kg/day - the basis for the chronic RfD. For chronic exposures, the hazard quotients are based on the provisional chronic RfD from U.S. EPA of 0.05 mg/kg/day.

Typical and lower estimates of exposure for all groups of workers approach, but don't exceed, a level of concern. At the upper application range, exposure levels slightly exceed the level of concern, with hazard quotients of 1.4. The health consequences of these exposure levels are uncertain but would be expected to be minimal. It is also important to keep in mind that the chronic RfD is based on daily, lifetime exposures, which are unlikely for a worker.

The accidental exposure scenario of wearing gloves contaminated with triclopyr for 1 hour exceeds the RfD for upper exposure levels (HQ = 1.7). Although it is unlikely that a one-time exposure to triclopyr at this level would result in toxic effects, this scenario indicates that adequate worker hygiene practices are important. As stated above, workers applying triclopyr only occasionally would be at much lower risk of such an accident. If a worker applies triclopyr often, and is sloppy with industrial hygiene, some effects to the kidney are plausible. The simple verbal interpretation of this quantitative characterization of risk is that under the most conservative set of accidental exposure assumptions, workers could be exposed to levels of triclopyr that are regarded as unacceptable. If triclopyr is not applied at the highest application and concentration rate or if appropriate steps are taken to ensure that workers are not exposed to the maximum plausible rates (i.e., worker hygiene practices) the risk to workers would be substantially reduced.

General Public – As with the corresponding worksheet for workers, the hazard quotients for acute exposure are based on acute RfD of 1.0 mg/kg/day and the hazard quotients for chronic exposures are based on the chronic RfD from U.S. EPA of 0.05 mg/kg/day. For women of childbearing age, the acute RfD is 0.05 mg/kg/day.

One acute/accidental scenario (the consumption of contaminated vegetation) exceeds a level of concern at all levels of exposure (HQ = 1 to 65). These findings suggest that in the unlikely event that someone had a vegetable garden growing in proximity to a treatment area that triclopyr was applied, especially at the typical or maximum application rates, adult females who consume the vegetables from such gardens could be at risk. At the typical level of exposure, the consumption of contaminated vegetation could lead to acute exposures where the nature and severity of effects are uncertain. At the upper level of exposure, the consumption of contaminated vegetation could lead to a one-time dose of 3.2 mg/kg which could result in overt signs or symptoms of toxicity after acute exposures. The plausibility of the existence of this scenario is limited by several important factors. First, the areas proposed for treatment with triclopyr are well removed (> 1 mile) from private residences, and hence, vegetable gardens. Secondly, unless the triclopyr contamination were to occur immediately before picking, it is plausible that the accidental contamination would kill the plants or diminish their capacity to yield consumable vegetation. Thirdly, this scenario is extremely conservative in that it does not consider the effects of washing contaminated vegetation in reducing doses. Finally, signs at likely access points informing the public that an area has been sprayed and the presence of dye on vegetation would reduce the potential that freshly sprayed material would be consumed.

In the other acute/accidental scenarios involving triclopyr, based on the high exposure assumptions, four of the acute/accidental scenarios reach or slightly exceed a level of concern (i.e., child sprayed, woman sprayed on lower legs, exposure to sprayed vegetation, and consumption of contaminated fruit). Based on the dose-severity relationship for triclopyr, at these levels of acute exposure (≤1.8 mg/kg), it is unlikely that there would be any adverse health effects associated with a one-time exposure.

Two longer term scenarios exceed a level of concern - the consumption of unwashed fruit and the consumption of unwashed vegetation. While the consumption of fruit slightly exceeds a hazard quotient of 1 at only the upper level of exposure, the consumption of vegetation exceeds a level of concern at both the typical and upper exposure level. At the highest application rate, the estimated dose at the upper level of exposure could be about 2.1 mg/kg/day. This value is in the range that, with longer term exposure, could result in effects on kidneys or offspring. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially. This is a standard scenario used in all Forest Service risk assessments and is extremely conservative – i.e., it assumes that vegetation that has been directly sprayed is harvested and consumed for a prolonged period of time. In addition, this scenario does not consider the effects of washing contaminated vegetation or the likelihood that such treated vegetation in older treated areas are expected to be dead, dying, chlorotic, brittle or deformed and hence undesirable to consume in the long-term.

Table 3-20e-1. Summary of Risk Characterization for Workers – Triclopyr

Chronic RfD = 0.05 mg/kg/day Acute RfD = 1.0 mg/kg/day			
Scenario	Hazard Quotient		
	Typical	Lower	Upper
General Exposures			
Backpack Application	0.3	1E-02	1.4
Accidental/Incidental Exposures			
Immersion of Hands - 1 Minute	0.02	8E-03	0.03
Contaminated Gloves - 1 Hour	0.9	0.5	**1.7**
Spill on Hands - 1 Hour	0.04	2E-04	0.06
Spill on Lower Legs - 1 Hour	9E-02	6E-04	0.1

Table 3-20e-2. Summary of Risk Characterization for the Public – Triclopyr

Chronic RfD = 0.05 mg/kg/day Acute RfD = 1.0 mg/kg/day			
Scenario	Hazard Quotient		
	Typical	Lower	Upper
Acute/Accidental Exposures			
Direct Spray, Entire Body, Child	**1.4**	9E-03	**2**
Direct Spray, Lower Legs, Woman	**3**	0.02	**5**
Dermal Exposure, Contaminated Vegetation	**3**	0.02	**4**
Contaminated Fruit	0.1	0.1	**1.7**
Contaminated Vegetation	**8**	**1.1**	**65**
Contaminated Water, Spill	0.5	0.3	0.8
Contaminated Water, Stream	5E-04	00	0.1
Consumption of Fish, General Public	1E-03	1E-03	1E-03
Consumption of Fish, Subsistence Populations	5E-03	5E-03	5E-03
Chronic/Longer Term Exposures			
Contaminated Fruit	0.07	0.04	**1.1**
Contaminated Vegetation	**4**	0.4	**43**
Consumption of Water	0.04	5E-03	0.08
Consumption of Fish, General Public	1E-05	2E-06	2E-05
Consumption of Fish, Subsistence Population	1E-04	2E-05	2E-04

Nonylphenol Polyethoxylate

Workers - Given the low hazard quotients for accidental exposure, the risk characterization is reasonably unambiguous. None of the accidental exposure scenarios exceed a level of concern. While the accidental exposure scenarios are not the most severe one might imagine (e.g., complete immersion of the worker or contamination of the entire body surface for a prolonged period of time) they are representative of reasonable accidental exposures. Confidence in this assessment is diminished by the lack of information regarding the dermal absorption kinetics of NP9E in humans. Nonetheless, the statistical uncertainties in the estimated dermal absorption rates, both zero-order and first-order, are incorporated into the exposure assessment and risk characterization.

The upper limit of general worker exposure scenarios approach, but don't exceed, a level of concern (HQ = 0.7). The simple verbal interpretation of this quantitative characterization of risk is that under the most conservative set of exposure assumptions, workers should not be exposed to levels of NP9E that are regarded as unacceptable.

NP9E can cause irritation and damage to the skin and eyes. Quantitative risk assessments for irritation are not derived; however, from a practical perspective, eye or skin irritation is likely to be the only overt effect as a consequence of mishandling NP9E. These effects can be minimized or avoided by prudent industrial hygiene practices during the handling of NP9E.

General Public –Although there are several uncertainties in the longer-term exposure assessments for the general public, the upper limits for hazard indices are sufficiently far below a level of concern that the risk characterization is relatively unambiguous: based on the available information and under the foreseeable conditions of application, there is no route of exposure or scenario suggesting that the general public will be at any substantial risk from longer-term exposure to NP9E.

For the acute/accidental scenarios, exposure resulting from the consumption of contaminated water from a spill is of greatest concern. Exposure resulting from the consumption of contaminated vegetation is of somewhat less concern. None of the other acute exposure scenarios represent a risk of effects to the public from NP9E exposure.

Acute or accidental exposure scenarios involving consumption of contaminated water or consumption of contaminated vegetation represent some risk of effects. None of the other acute exposure scenarios represent a risk of effects to the public from NP9E exposure. At typical rates of application, the drinking of contaminated water after a spill (HQ = 4.6) approaches the level that could present a risk of subclinical effects to the liver and kidney (HQ values between 5 and 10). The upper HQ of 6.8 represents an increasing risk of clinical effects to the kidney, liver, and other organ systems. The exposure scenario for the consumption of contaminated water is an arbitrary scenario: scenarios that are more or less severe, all of which may be equally probable or improbable, easily could be constructed. All of the specific assumptions used to develop this scenario have a simple linear relationship to the resulting hazard quotient. Thus, if the accidental spill were to involve 20 rather than 200 gallons of a field solution of NP9E, all of the hazard quotients would be a factor of 10 less. This scenario involving water contamination assumes that a small pond is affected, rather than a creek or river as would be more likely in this forested setting. The contaminated stream scenario presents a more realistic scenario for potential operational contamination of a stream; the HQ values are substantially below one

At high application rates only (HQ = 3.7) the short-term consumption of fruit also approaches the level that could present a risk of subclinical effects to the liver and kidney (HQ values between 5 and 10). At the typical rate of application, the HQ is less than one. Signing and the presence of dye on vegetation would reduce the potential of freshly sprayed material to be consumed.

The public exposure scenario involving the consumption of fruit, both short-term (above) and long-term, most closely proxies the use of native material by basketweavers. The highest estimated HQ value for the long-term exposure scenario is 0.7. Plant materials in older treated areas are expected to be dead, dying, chlorotic, brittle or deformed and hence undesirable and very unlikely to be selected for basketweaving, medicine or food (Segawa, R., et al, 2001), reducing the likelihood of additive doses.

Table 3-20f-1. Summary of Risk Characterization for Workers – Nonylphenol Polyethoxylate

RfD = 0.10 mg/kg/day			
Scenario	Hazard Quotient		
	Typical	Lower	Upper
General Exposures			
Backpack Application	0.12	0.0048	0.7
Accidental/Incidental Exposures			
Immersion of Hands - 1 Minute	0.0017	0.0006	0.004
Contaminated Gloves - 1 Hour	0.1	0.037	0.26
Spill on Hands - 1 Hour	0.0005	8 E-5	0.007
Spill on Lower Legs - 1 Hour	0.0013	0.0002	0.017

Table 3-20f-2. Summary of Risk Characterization for the Public – Nonylphenol Polyethoxylate

RfD = 0.10 mg/kg/day			
Scenario	Hazard Quotient		
	Typical	Lower	Upper
Acute/Accidental Exposures			
Direct Spray, Entire Body, Child	0.02	3E-03	0.26
Direct Spray, Lower Legs, Woman	2E-03	3E-04	0.03
Dermal Exposure, Contaminated Vegetation	4E-03	4E-04	0.05
Contaminated Fruit	0.24	0.16	3.7
Contaminated Water, Spill	4.6	2.8	6.8
Contaminated Water, Stream	9E-03	1E-03	0.04
Consumption of Fish, General Public	0.14	0.14	0.14
Consumption of Fish, Subsistence Populations	0.67	0.67	0.67
Chronic/Longer Term Exposures			
Contaminated Fruit	4E-03	3E-03	0.06
Consumption of Water	2E-03	0	5E-03
Consumption of Fish, General Public	1E-05	0	2E-05
Consumption of Fish, Subsistence Population	8E-05	0	2E-04

Hexachlorobenzene

Workers –For general worker exposures, the hazard quotients associated with hexachlorobenzene are approximately two to three orders of magnitude below the corresponding hazard quotients for clopyralid. Similarly, hazard quotients associated with accidental scenarios are consistently lower for hexachlorobenzene than the corresponding scenarios for clopyralid. Thus, for the reasonably diverse exposure scenarios covered in this risk assessment, the amount of hexachlorobenzene in technical grade clopyralid is not toxicologically significant.

The cancer risks presented in Table 3-20g-3 are presented as the estimated exposure divided by the lifetime dose associated with a cancer risk of 1 in one million. Thus, the interpretation of these hazard quotients is identical to that of hazard quotients for toxicity – i.e., if the hazard quotient is below unity, the cancer risk is below 1 in one million. As indicated in Table 3-20g-3, none of the cancer risks in workers exceed 1 in one million.

While there are substantial uncertainties involved in any cancer risk assessment, the verbal interpretation of the numeric risk characterization derived in this risk assessment is relatively simple. Using the assumptions and methods typically applied in Forest Service risk assessments, there is no plausible basis for asserting that the contamination of clopyralid with hexachlorobenzene will result in any substantial risk of cancer in workers applying clopyralid under normal circumstances.

While the chronic cancer potency could be scaled linearly and the cancer risk associated with short term exposures could be calculated, this sort of extrapolation is highly uncertain and, more importantly, ignores the normal background exposures to hexachlorobenzene from other sources. For example background levels of exposure to hexachlorobenzene are in the range of 0.000001 mg/kg/day or 1×10^{-6} mg/kg/day. As summarized in Table 3-20g-3, even the upper range general worker exposure values are below this background dose – i.e., 1.9×10^{-8} mg/kg/day. As discussed in the next section, the upper range of the longer term exposure scenarios for the general public are substantially below the background dose – i.e., about 5×10^{-9} to 2×10^{-11}. Thus, there is no basis for asserting that the presence of pentachlorobenzene or hexachlorobenzene in clopyralid will impact substantially the cancer risk under conditions characteristic of applications made in this project.

As indicated in Section 2, all of these risk characterizations are based on the typical or average 2.5 ppm concentration of hexachlorobenzene in technical grade clopyralid. This is the upper range of hexachlorobenzene that may be expected in technical grade clopyralid and thus the actual risks are probably much lower than those given in these tables.

While there are substantial uncertainties involved in any cancer risk assessment, the verbal interpretation of the numeric risk characterization derived in this risk assessment is relatively simple. Using the assumptions and methods typically applied in Forest Service risk assessments, there is no plausible basis for asserting that the contamination of clopyralid with pentachlorobenzene or hexachlorobenzene will result in any substantial risk of cancer in workers applying clopyralid under normal circumstances.

The above discussion is not to suggest that general exposures to hexachlorobenzene – i.e., those associated with normal background exposures that are not related to Forest Service applications of clopyralid – are acceptable. At background exposure levels of about 1×10^{-6} mg/kg/day, the background risk associated with exposure to hexachlorobenzene would be 0.0000016 or about 1 in 625,000.

General Public –As with the corresponding worksheet for workers, the hazard quotients for acute exposure are based on the short-term MRL of 0.008 mg/kg/day and the hazard quotients for chronic exposures are based on the U.S. EPA RfD of 0.0008 mg/kg/day.

All exposure scenarios result in hazard quotients that are below unity - i.e., the level of exposure is below the RfD for chronic exposures and below the MRL for acute exposures. In addition, all of the acute exposure scenarios result in hazard quotients that are substantially below the corresponding hazard quotient for clopyralid. The highest acute hazard quotient for hexachlorobenzene is about 0.006, the upper range of the hazard quotient associated with the consumption of contaminated fish by subsistence populations. The consumption of fish contaminated with hexachlorobenzene is a primary exposure scenario of concern because of the tendency of hexachlorobenzene to bio-concentrate from water into fish. For chronic exposures, the highest chronic HQ is about 0.00002, the upper range of the hazard quotient associated with the consumption of fish by subsistence populations. This is also consistent with the general observation that exposure to hexachlorobenzene occurs primarily through the consumption of contaminated food.

As with worker exposures, none of the hazard quotients for cancer risk levels of 1 in 1-million exceed unity. As indicated in Table 3-20g-4, the highest longer-term exposure rate associated with Forest Service programs is 1.45×10^{-8} mg/kg/day – i.e., the upper range of exposure for the consumption of contaminated fish by subsistence populations. This is below the typical background exposure by a factor of about 70.

No explicit dose response assessment is made for the potential carcinogenic effects of pentachlorobenzene, another impurity in clopyralid. Based on the comparison of apparent toxic potencies and the relative amounts of both hexachlorobenzene and pentachlorobenzene in clopyralid, a case could be made for suggesting that pentachlorobenzene may double the cancer risk over that associated with hexachlorobenzene. Given the extremely low levels of estimated cancer risk, this has essentially no impact on the risk characterization.

The simple verbal interpretation of this risk characterization is that, in general, the contamination of clopyralid with hexachlorobenzene and pentachlorobenzene does not appear to pose a risk to the general public. This is consistent with the conclusions reached by the U.S. EPA (1995a, as referenced in SERA 1999).

As indicated in Section 2, all of these risk characterizations are based on the typical or average 2.5 ppm concentration of hexachlorobenzene in technical grade clopyralid. This is the upper range of hexachlorobenzene that may be expected in technical grade clopyralid and thus the actual risks are probably much lower than those given in these tables.

Table 3-20g-1. Summary of Risk Characterization for Workers – Hexachlorobenzene

Chronic RfD = 0.0008 mg/kg/day Acute MRL = 0.008 mg/kg/day			
Scenario	Hazard Quotient		
	Typical	Lower	Upper
General Exposures			
Backpack Application	5E-06	1E-07	2E-05
Accidental/Incidental Exposures			
Immersion of Hands - 1 Minute	6E-05	2E-05	2E-04
Contaminated Gloves - 1 Hour	4E-03	1E-03	1E-02
Spill on Hands - 1 Hour	8E-07	2E-07	3E-06
Spill on Lower Legs - 1 Hour	2E-06	4E-07	8E-06

Table 3-20g-2. Summary of Risk Characterization for the Public – Hexachlorobenzene

Chronic RfD = 0.0008 mg/kg/day Acute MRL = 0.008 mg/kg/day			
Scenario	Hazard Quotient		
	Typical	Lower	Upper
Acute/Accidental Exposures			
Direct Spray, Entire Body, Child	3E-05	6E-06	1E-04
Direct Spray, Lower Legs, Woman	3E-06	6E-07	1E-05
Dermal Exposure, Contaminated Vegetation	9E-07	9E-08	2E-06
Contaminated Fruit	2E-06	7E-07	1E-05
Contaminated Water, Spill	2E-05	1E-05	3E-05
Contaminated Water, Stream	5E-07	1E-09	3E-06
Consumption of Fish, General Public	1E-03	1E-03	1E-03
Consumption of Fish, Subsistence Populations	6E-03	6E-03	6E-03
Chronic/Longer Term Exposures			
Contaminated Fruit	6E-07	6E-08	6E-06
Consumption of Water	1E-08	2E-10	3E-08
Consumption of Fish, General Public	1E-06	3E-08	2E-06
Consumption of Fish, Subsistence Population	9E-06	2E-07	2E-05

Table 3-20g-3. Summary of Cancer Risk Assessment for Workers – Hexachlorobenzene – Relative to Risk Level of 1 in 1 Million

Adjusted Cancer Potency Parameter = 6.26 E-5 $(mg/kg/day)^{-1}$	
Scenario	Cancer Risk Divided by 1 in 1 Million

Table 3-20g-4. Summary of Cancer Risk Assessment for Public – Hexachlorobenzene Relative to Risk Level of 1 in 1 Million

Adjusted Cancer Potency Parameter = 6.25 E-7 $(mg/kg/day)^{-1}$			
Scenario	Cancer Risk Divided by 1 in 1 million		
	Typical	Lower	Upper
Chronic/Longer Term Exposures			
Contaminated Fruit	8E-04	8E-05	7E-03
Consumption of Water	1E-05	2E-07	3E-05
Consumption of Fish, General Public	1E-03	3E-05	3E-03
Consumption of Fish, Subsistence Population	1E-02	3E-04	2E-02

Additives, Synergistic Effects, and Sensitive Individuals

Additives (Adjuvants)

The use of the NPE-based surfactants (such as R-11®) is analyzed in this risk assessment, and its use under typical conditions should result in acceptable levels of risk to workers and the public. As with the herbicides, eye and skin irritation may be the only manifestations of exposure seen in the absence of spills and accidents. The exposure to ethylene oxide as a contaminant of NPE-based surfactants should also be at acceptable levels of risk.

Colorfast Purple Colorant (SERA 1997b)

The active ingredients in Colorfast Purple are acetic acid, dipropylene glycol, and Basic Violet 3. The exact amounts of the ingredients in this product are considered proprietary. Acetic acid, a major component of vinegar, is on the EPA's list 4A of inerts. Dipropylene glycol is on EPA's list 3 of inerts. None of the ingredients in this product are known to be on EPA List 1 or 2. Basic Violet 3 dye is the colorant in Colorfast Purple. Most of the information about its toxicological effects are attributed to the chloride salt, commonly referred to as Gentian Violet. Gentian Violet is used as an antifungal agent, a treatment for oral infections, and as laboratory reagent and stain (SERA 1997b). Based on the MSDS no toxic chemicals are present that are subject to the reporting requirement of the Emergency Planning and Community Right-to-Know Act (EPCRA, also referred to as SARA Title III) and 40CFR372 (Toxic Chemical Release Reporting: Community Right-to-Know). In a Study by Littlefield et al (in SERA 1997b) marked carcinogenic activity was observed in mice, and is the basis for a qualitative cancer risk assessment in SERA (1997b). Based on SERA 1997b, risk characterization leads to typical cancer risks for workers of 4.7×10^{-7} or 1 in 2.1 million. For the public, the consumption of sprayed berries yielded an estimated single exposure risk of 1 in 37 million to 1 in 294 million. For public exposures, it is expected that the dye would reduce exposures both to itself and to the other chemicals it might be mixed with (herbicide and other adjuvants) as the public would be alerted to the presence of treated vegetation.

Hi-Light® Blue (USDA, 2007a)

Hi-Light® Blue dye is not required to be registered as a pesticide; therefore it has no signal word associated with it. It is mildly irritating to the skin and eyes. It would likely be considered a Category III or IV material and have a Caution signal word if it carried one.

Hi-Light® Blue is a water-soluble dye that contains no listed hazardous substances. It is considered to be virtually non-toxic to humans. The dye used in Hi-Light® Blue is commonly used in toilet bowl cleaners and as a colorant for lakes and ponds (SERA 1997b).

MSO-based and Silicone/MSO blend surfactant (USDA, 2007a)

Surfactants consisting of vegetable oil and a blend of silicone-based surfactant and vegetable oil are proposed for use. A brief discussion of silicone-based and oil-based surfactants is below. An analysis of the ingredients in these adjuvants did not identify any of specific toxic concern with the exception of the ingredients discussed in this risk assessment (ibid). None were on U.S. EPA Inerts Lists 1 or 2.

The primary summary statement that can be made is that the more common risk factors for the use of these adjuvants are through skin or eye exposure. These adjuvants all have various levels of irritancy associated with skin or eye exposure. This points up the need for good industrial hygiene practices while utilizing these products, especially when handling the concentrate, such as during mixing. The use of chemical resistant gloves and goggles, especially while mixing, should be observed.

Silicone-Based Surfactants

Also known as organosilicones, these are increasing in popularity because of their superior spreading ability. This class contains a polysiloxane chain. Some of these are a blend of non-ionic surfactants and silicone while others are entirely silicone. The combination of non-ionic surfactants and silicone surfactants can increase absorption into a plant so that the time between application and rainfall can be shortened. This is known as rainfastness. The surfactants extreme spreading ability may lead to droplet coalescence and subsequent runoff if applied at inappropriately high rates.

Based on a review of the current research, it would appear that surfactants have the potential to affect terrestrial insects. However, as is true with many toxicity issues, it would appear that any effect is dose related. The research does indicate that the silicone-based surfactants, because of their very effective spreading ability, may represent a risk of lethality through the physical effect of drowning, rather than through any toxicological effects. Silicone surfactants are typically used at relatively low rates and are not applied at high spray volumes because they are very effective surfactants. Hence it is unlikely that insects would be exposed to rates of application that could cause the effects noted in these studies. Other surfactants, which are less effective at reducing surface tension, can also cause the drowning effect. But as with the silicones, exposures have to be high, to the point of being unrealistically high, for such effects.

Vegetable Oils

The methylated seed oils are formed from common seed oils, such as canola, soybean, or cotton. They act to increase penetration of the herbicide. These are comparable in performance to crop oil concentrates. In addition, silicone-seed oil blends are also available that take advantage of the spreading ability of the silicones and the penetrating characteristics of the seed oils.

The U.S. Food and Drug Administration (FDA) considers methyl and ethyl esters of fatty acids produced from edible fats and oils to be food grade additives (CFR 172.225). Because of the lack of exact ingredient statements on these surfactants, it is not always clear whether the oils that are used in them meet the U.S. FDA standard.

Synergistic Effects

Synergistic effects (multiplicative) are those effects resulting from exposure to a combination of two or more chemicals that are greater than the sum of the effects of each chemical alone (additive). See pages 4-111 through 4-114 in USDA 1989b, for a detailed discussion on synergistic effects. Instances of chemical combinations that cause synergistic effects are relatively rare at environmental exposure levels. Reviews of the scientific literature on toxicological effects and toxicological interactions of agricultural chemicals indicate that exposure to a mixture of pesticides is more likely to lead to additive rather than synergistic effects (US EPA 2000c; ATSDR 2004; Kociba and Mullison 1985, Crouch et al. 1983, EPA 1986).

Synergism generally has not been observed in toxicological tests involving combinations of commercial pesticides. The herbicide and additives proposed for this project have not shown synergistic effects in humans who have used them extensively in forestry and other agricultural applications. However, synergistic toxic effects of herbicide combinations, combinations of the herbicides with other pesticides such as insecticides or fertilizers, or combinations with naturally occurring chemicals in the environment are not normally studied. Based on the limited data available on pesticide combinations involving these herbicides, it is possible, but unlikely, that synergistic effects could occur as a result of exposure to the herbicides considered in this analysis.

It is not anticipated that synergistic effects would be seen with the herbicides and the adjuvants that might be added to them. Based on a review of several recent studies, there is no demonstrated synergistic relationship between herbicides and surfactants (Abdelghani et al 1997; Henry et al 1994; Lewis 1992; Oakes and Pollak 1999, 2000 as referenced in USDA 2007a). Synergistic effects are not expected from multiple exposures to NP, NPEs, and their breakdown products (Payne et al 2000, Environment Canada 2001, as referenced in USDA 2003b).

However, even if synergistic or additive effects were to occur as a result of the proposed treatment, these effects are dose responsive (Dost 1991). This means that exposures to the herbicide plus any other chemical must be significant for these types of effects to be of a biological consequence. Based on the very low exposure rates estimated for this alternative, synergistic or additive effects, if any, are expected to be insignificant.

Although the combination of surfactant and herbicide might indicate an increased rate of absorption through the skin, a review of recent studies indicates this is not often true (USDA 2007a). For a surfactant to increase the absorption of another compound, the surfactant must affect the upper layer of the skin. Without some physical effect to the skin, there will be no change in absorption as compared to the other compound alone. The studies indicate that in general non-ionic surfactants have less of an effect on the skin, and hence absorption, then anionic or cationic surfactants. Compound specific studies indicate that the alkylphenol ethoxylates generally have little or no effect on absorption of other compounds. In several studies, the addition of a surfactant actually decreased the absorption through the skin. It would appear that there is little support for the contention that the addition of surfactants to herbicide mixtures would increase the absorption through the skin.

Herbicide-Specific Interaction Data

The manufacturers recommend that chlorsulfuron formulations be mixed with a non-ionic surfactant. There is no published literature or information in the US EPA files that would permit an assessment of toxicological effects or risk assessment of chlorsulfuron mixed with a surfactant (SERA, 2004a).

Clopyralid may be applied in combination with other herbicides, particularly in combination with picloram. There are no data in the literature suggesting that clopyralid will interact, either synergistically or antagonistically with this or other compounds (SERA 1999).

There is very little information available on the interaction of glyphosate with other compounds. The available data do not suggest a synergistic interaction between glyphosate and the POEA surfactant found in some formulations (e.g., Roundup) from plausible routes of exposure (SERA 1996a).

There is very little information available on the interaction of triclopyr with other compounds. The available data do not suggest a synergistic interaction between the triclopyr active ingredient and the other components in the commercial triclopyr formulations of Garlon 4 (SERA 1996b).

There is very little information available on the interaction of hexazinone with other compounds. The available data suggest that hexazinone may be metabolized by and may induce cytochrome P-450 (SERA 1997a). This is a very important enzyme in the metabolism of many endogenous as well as xenobiotic compounds. Thus, it is plausible that the toxicity of hexazinone may be affected by and could affect the toxicity of many other agents. The nature of the potential effect (i.e., synergistic or antagonistic) would depend on the specific compound and perhaps the sequence of exposure.

Sensitive Individuals

The uncertainty factors used in the development of the RfD takes into account much of the variation in human response. The uncertainty factor of 10 for sensitive subgroups is sufficient to ensure that most people will experience no toxic effects. *Sensitive* individuals are those that might respond to a lower dose than average, which includes women and children. The National Academy of Sciences report entitled Pesticides in the Diets of Infants and Children (NAS 1993) found that quantitative differences in toxicity between children and adults are usually less than a factor of approximately 10-fold. An uncertainty factor of 10 may not cover individuals that may be sensitive to herbicides because human susceptibility to toxic substances can vary by two to three orders of magnitude. Factors affecting individual susceptibility include diet, age, heredity, preexisting diseases, and life style. Individual susceptibility to the herbicides proposed in this project cannot be specifically predicted. Unusually sensitive individuals may experience effects even when the HQ is equal or less than 1.

There is no information to suggest that specific groups or individuals may be especially sensitive to the systemic effects of chlorsulfuron. Due to the lack of data in humans, the likely critical effect of chlorsulfuron in humans cannot be identified clearly. In animals the most sensitive effect of chlorsulfuron appears to be weight loss. There is also some evidence that chlorsulfuron may produce alterations in hematological parameters. However, it is unclear if individuals with pre-existing diseases of the hematological system or metabolic disorders would be particularly sensitive to chlorsulfuron exposure. Individuals with any severe disease condition could be considered more sensitive to many toxic agents.

The 1996 Food Quality Protection Act requires that U.S. EPA evaluate an additional 10X safety factor, based on data uncertainty or risks to certain age/sex groupings. U.S. EPA has evaluated chlorsulfuron against this standard and has recommended a 3X additional safety factor be used for the protection of infants and children. This additional 3X safety factor is factored into the acute and chronic RfD's of this risk assessment as it applies to chlorsulfuron.

The likely critical effect of clopyralid in humans cannot be identified clearly (SERA 2004b). Clopyralid can cause decreased body weight, increased kidney and liver weight, The likely factor deceased rTJ-16.2186 74 0 elof 1 T condition could be considered more sensitive to many toxic agents. There are no data or case reports on idiosyncratic responses to clopyralid (*ibid*).

No reports were encountered in the glyphosate literature leading to the identification of sensitive subgroups. There is no indication that glyphosate causes sensitization or allergic responses, which does not eliminate the possibility that some individuals might be sensitive to glyphosate as well as many other chemicals (SERA 2003a).

Because triclopyr may impair glomerular filtration, individuals with pre-existing kidney diseases are likely to be at increased risk (SERA 1996b). Because the chronic RfD for triclopyr is based on reproductive effects, women of child-bearing age are an obvious group at increased risk (SERA 2003b). This group is given explicit consideration and is central to the risk characterization.

Because hexazinone was demonstrated to induce fetal resorptions, pregnant women are an obvious group at increased risk (SERA 2005). This group is given explicit consideration and is central to the risk characterization. There are no other reports in the literature suggesting subgroups that may be sensitive to hexazinone exposure. There is no indication that hexazinone causes sensitization or allergic responses (*ibid*).

NP9E can cause increases in kidney and liver weight, and effects to kidney function and structure. Thus, individuals with pre-existing conditions that involve impairments of the kidney or liver may be more sensitive to this compound. There is some indication that sensitive individuals may develop contact allergies. People with a history of skin allergic reactions to soaps and detergents may be especially sensitive to dermal exposures of NP9E-based surfactants.

The potential of NP9E to induce reproductive effects (described in section 2 of Appendix D) should be considered low. Based on the available dose/duration/severity data, it appears that exposure levels below those associated with the most sensitive effect (i.e., kidney effects) are not likely to be associated with reproductive toxicity. However, as shown in the exposure scenarios, there is the potential for acute exposures to be in the range (considering a 100X safety factor) where effects to the developing fetus may occur, therefore women of child-bearing age could be considered a sensitive population.

Cumulative Effects

The proposed use of herbicides could result in cumulative doses of herbicides to workers or the general public. Cumulative doses to the same herbicide result from (1) additive doses resulting from various routes of exposure from this project and (2) additive doses if an individual is exposed to other herbicide treatments.

Additional sources of exposure include: use of herbicides on adjacent private lands, use of herbicides on adjacent NFS lands, or home use by a worker or member of the general public. Reported past use of glyphosate, hexazinone, chlorsulfuron, triclopyr, and clopyralid (1999-2006) in El Dorado County is displayed in Table 3-21, below, by total use and Forestland use. Hexazinone is used primarily for forestland. Glyphosate is primarily used in forestland (41%), other crops, right-of-way, and landscape maintenance. Chlorsulfuron is primarily used in right-of-way and landscape maintenance. Triclopyr is primarily used in forestland (28%), right-of-way, and landscape maintenance. Clopyralid is primarily used for forestland (14%), rangeland, landscape maintenance, and right-of-way. We assume that there would not be any extensive changes in these use patterns into the near future.

Table 3-21. Reported Herbicide Use (lbs active ingredient) in El Dorado County (1999-2006)

Forestland Total									
Chemical	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Total**
Chlorsulfuron	0	0	0	0	0	0	0	0	0
Glyphosate	7,881	5,324	7,231	3,709	3,183	2,561	6,471	6,271	42,631
Clopyralid	51	0	89	88	14	51	24	18	335
Hexazinone	3,081	2,569	3,778	3,554	1,772	5,549	1,474	4,895	26,672
Triclopyr	541	770	633	978	69	67	532	50	3,640
All Reported Uses									
Chemical	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Total**
Chlorsulfuron	3	3	4	7	3	8	23	46	97
Glyphosate	13,054	9,482	11,113	9,596	10,640	14,927	15,508	19,921	104,241
Clopyralid	178	103	376	400	468	222	224	372	2,343
Hexazinone	3,154	2,695	3,826	3,559	1,559	5,673	1,523	4,935	26,924
Triclopyr	1,336	1,504	1,521	1,904	2,101	1,076	1,900	1,438	12,780

Source - California Department of Pesticide Regulation, Annual (1999-2006) Pesticide Use Reports for El Dorado County, accessed on line at http://www.cdpr.ca.gov/docs/pur/purmain.htm on 7/31/2008).

Additional sources of exposure on National Forest Lands – Past use on the ENF (1999-2005) of glyphosate, hexazinone, triclopyr, and clopyralid are displayed in Table 3-22, below. Chlorsulfuron hasn't been used on the ENF. R-11 surfactant is assumed to have been used in all glyphosate and clopyralid applications. There is the potential for exposure from projects on the ENF involving the herbicides proposed for use on this project. They include the Yellow Starthistle Control Project (clopyralid and glyphosate), Spotted Knapweed Control Project (glyphosate), PGE/SMUD Transmission line (clopyralid), Star Fire Reforestation Project (glyphosate), 2004 Vegetation Management in Conifer Plantations (glyphosate, clopyralid, and hexazinone) and Bosworth Forest Health project (glyphosate and triclopyr). This project would add an estimated maximum of 33,000 lbs (AI) of glyphosate, 280 lbs (AI) of hexazinone and 25 lbs (AI) of clopyralid, 240 lbs (AI) triclopyr, and < 1 lb. of chlorsulfuron over the life of the project. We assume that there would not be any extensive changes in these use patterns into the near future, with the following exception. Use of glyphosate and triclopyr on NFS land may increase over 1999-2005 levels for due to its possible use for reforestation on the Power Fire and the Big Grizzly Fuel Reduction Project.

Table 3-22. Herbicide Use (lbs active ingredient) Eldorado National Forest (1999-2005)

Year	Clopyralid	Glyphosate	Triclopyr	Hexazinone
1999	0	8,017	0	122
2000	0	3,315	395	180
2001	1	2,979	0	0
2002	46	940	612	0
2003	11	770	31	0
2004	27	4,978	0	0
2005	13	2,370	27	0

Eldorado National Forest includes portions of Alpine, Amador, El Dorado, and Placer Counties.

It is conceivable that workers or members of the public could be exposed to herbicides as a result of treatments on surrounding private forestlands (glyphosate and hexazinone) or treatments on NFS Lands. Where individuals could be exposed by more than one route, the risk of such cases can be quantitatively characterized by adding the hazard quotients for each exposure scenario. For example, using glyphosate as an example, the typical levels of exposure for a woman being directly sprayed on the lower legs, staying in contact with contaminated vegetation, eating contaminated fruit, and consuming contaminated fish leads to a combined hazard quotient of 0.04. Similarly, for all of the chronic glyphosate exposure scenarios, the addition of all possible pathways lead to hazard quotients that are substantially less than one. Similar scenarios can be developed with the other herbicides. This risk assessment specifically considers the effect of repeated exposure in that the chronic RfD is used as an index of acceptable exposure. Consequently, repeated exposure to levels below the toxic threshold should not be associated with cumulative toxic effects.

Since these herbicides persist in the environment for a relatively short time (generally less than 1 year), do not bio-accumulate, and are rapidly eliminated from the body, additive doses from re-treatments in subsequent years are not anticipated. According to recent work completed by the California Department of Pesticide Regulation, some plant material contained hexazinone residues for up to 2.5 years after treatment, triclopyr residues up to 1.5 years after treatment, and glyphosate up to 66 weeks after treatment; however, these levels were less than 1 part per million (Segawa et al. 2001). Since repeat treatments in this project are at one or more years into the future, it is likely that any residue from an application would be substantially degraded between applications. It is possible that residues from the initial herbicide application could still be detectable during subsequent re-treatments, but these plants would represent a low risk to humans as they would show obvious signs of herbicide effects as so would be undesirable for collection.

The information in Table 3-22 indicates that these herbicides are also used outside of forestlands in El Dorado County. In order to consider the cumulative effects of these other uses, U.S. EPA has developed the theoretical maximum residue contribution (TMRC). The TMRC (Table 3-23) is an estimate of maximum daily exposure to chemical residues that a member of the general public could be exposed to from all published and pending uses of a pesticide on a food crop. Adding the TMRC to this project's dose estimate can be used as an estimate of the cumulative effects of this project with theoretical background exposure levels of these herbicides. The result of doing this doesn't increase the HQ values appreciably.

Table 3-23. Theoretical Maximum Residue Contribution

Herbicide	TMRC (mg/kg/day)	% of RfD	Data Source
Chlorsulfuron	0.00386	19.3	US EPA 2002f
Clopyralid	0.00903	6.0	US EPA 1999
Glyphosate	0.02996	1.5	US EPA 2000a
Hexazinone	0.0035	7.0	US EPA 1994
Triclopyr	0.00105	2.1	US EPA 2002a

Cumulative effects can be caused by the interaction of different chemicals with a common metabolite or a common toxic action. With the exception of triclopyr and chlorpyrifos discussed below, none of the other herbicides have been demonstrated to share a common metabolite with other pesticides. Although concern has been expressed about a possible link between the toxic effects of other triazine herbicides, such as atrazine, and the herbicide hexazinone, no studies on hexazinone have supported such a link. These two herbicides, while having some commonality in chemical structure, are dissimilar enough chemically that common toxic action is not expected.

The primary metabolite of triclopyr is 3,5,6-trichloro-2-pyridinol (TCP). TCP is also the primary metabolite of an insecticide called chlorpyrifos. U.S. EPA (1998, 2002a) considered exposures to TCP from both triclopyr and chlorpyrifos in their general dietary and drinking water exposure assessments. Based on this assessment, the U.S. EPA (1998) concluded that:

> *...the existing uses of triclopyr and chlorpyrifos are unlikely to result in acute or chronic dietary risks from TCP. Based on limited available data and modeling estimates, with less certainty, the Agency concludes that existing uses of triclopyr and chlorpyrifos are unlikely to result in acute or chronic drinking water risks from TCP. Acute and chronic aggregate risks of concern are also unlikely to result from existing uses of triclopyr and chlorpyrifos.* – U.S. EPA (1998, p. 34).

This conclusion, however, is based primarily on the agricultural uses of triclopyr – i.e., estimated dietary residues – and does not specifically address potential exposures from forestry applications. In forestry applications, the primary concern would be the formation of TCP as a soil metabolite. TCP is more persistent than triclopyr in soil and TCP is relatively mobile in soil (U.S. EPA 1998) and could contaminate bodies of water near the site of application. In order to assess the potential risks of TCP formed from the use of triclopyr, the TCP metabolite was modeled in the SERA risk assessment (SERA 2003b) along with triclopyr.

Because triclopyr and chlorpyrifos degrade at different rates, maximum concentration in soil, and hence maximum runoff to water, will occur at different times. Thus, in order to provide the most conservative estimate of exposure to TCP, the maximum concentrations reflect applications of triclopyr and chlorpyrifos spaced in such a way as to result in the maximum possible concentrations of TCP in water. As modeled, concentrations of TCP in a small stream could reach up to 11 ppb from the use of triclopyr at a rate of 1 lb/acre and up to 68 ppb in a small stream from the use of triclopyr at a rate of 1 lb/acre and chlorpyrifos at a rate of 1 lb/acre.

The current RfD for TCP used by U.S. EPA (2002a) is 0.012 mg/kg/day for chronic exposure and 0.025 mg/kg/day for acute exposure. The child is the most exposed individual, consuming 1L of water per day at a body weight of 10 kg. Thus, based on the chronic RfD of 0.012 mg/kg/day, the associated concentration in water would be 0.12 mg/L or ppm [0.012 mg/kg/day × 10 kg/1 L/day] which is in turn equivalent to 120 ppb. Since the peak exposure to TCP in water is below the concentration associated with the chronic RfD, there is no basis for asserting that the use of triclopyr with or without the use of chlorpyrifos will result in hazardous exposures of humans to TCP.

Recent studies have shown drift of chlorpyrifos, and other insecticides, from agricultural lands in the Sacramento/San Joaquin Valley to the Sierra Nevada range (McConnell et al. 1998). In El Dorado County, chlorpyrifos use in 2004 totaled 181 pounds, primarily used in wine grapes, landscape maintenance, and structural pest control. Levels of chlorpyrifos have been measured in watercourses in the Sierra Nevada as high as 13 ng/L (0.013 μg/L or ppb). These upper levels have been measured in the southern Sierra. As a comparison, the use of chlorpyrifos in Fresno County was over 291,000 pounds, 1,600 times higher in 2004 than El Dorado County. This would indicate that it is unlikely that such high aquatic levels of chlorpyrifos would be found in the ENF area as a result of atmospheric movement. Assuming that 100% of measured chlorpyrifos would degrade to TCP (an over-exaggeration of the rate of degradation), this would add 0.013 ppb of TCP. If this amount is added to the modeled peak exposure of 68 ppb, it would not result in any appreciable increase in risk

Estrogenic effects (a common toxic action) can be caused by additive amounts of NP, NPE, and their breakdown products. In other words, an effect could arise from the additive dose of a number of different xenoestrogens (estrogens from outside the body), none of which individually have high enough concentrations to cause effects. This can also extend out to other xenoestrogens that biologically react the same. Additive effects, rather than synergistic effects, are expected from combinations of these various estrogenic substances.

Other sources of exposure to NP and NPEs include personal care products (skin moisturizers, makeup, deodorants, perfumes, spermicides), detergents and soaps, foods, and from the environment away from the forest herbicide application site. In addition to xenoestrogens, humans are exposed to various phytoestrogens, which are hormone-mimicking substances naturally present in plants. In all, more than 300 species of plants in more than 16 families are known to contain estrogenic substances, including beets, soybeans, rye grass, wheat, alfalfa, clover, apples, and cherries. Adding together the contributions from the worst-case background environment and consumer products, there would be a background dose to a female worker of 27.034 mg/kg/day (assuming 100% dermal absorption) or 0.304 mg/kg/day (assuming 1% dermal absorption). Using a derived NP human NOEL (no observed effects level) of 0.10 mg/kg/day (as described in USDA, 2003b) these exposure estimates result in hazard quotients of 270 to 3. In terms of this risk assessment, the non-acute contribution of NP9E (backpack workers exposure ranged from 0.01 to 0.07 mg/kg/day) would contribute up to 0.7 to any hazard quotient. At typical application rates, the worker exposure would add 0.1 to the HQ. For the public chronic exposures at the upper range of application, the doses of NP9E would add 0.00002 to 0.06 to any HQ. These may be negligible depending upon the background exposures, lifestyles, absorption rates, and other potential chemical exposures that are used to determine overall risk to environmental xenoestrogens.

Soil Quality

Affected Environment

Soils within the planting area for this project are derived from granitic, gabbroic, and volcanic parent materials. Maps showing the type and arrangement of soils found in the project area are found in the Eldorado National Forest Soil Survey (Mitchell and Silverman, 1985). Field work in the project area by the BAER team soil scientist, and the Freds Fire project soil scientists (USDA 2005b) verified the existing soil survey information, investigated soil conditions and effects of the fire, and management capabilities. Further field visits were made in summer 2006 for observations of post-harvest conditions. The soils are described in this section by bedrock (parent material) type.

Soils Developed from Granitic Materials

Some of the soils found in the project area developed from granitic parent materials. These soils are located primarily on the steep north slopes of the South Fork American River. The Chaix and Pilliken soil series are the dominant granitic-derived soils. The Chaix is moderately deep, somewhat excessively drained, and has coarse sandy loam texture throughout. The Pilliken soil is deep, well drained, and has a coarse sandy loam texture throughout.

Soils Developed from Volcanic Materials

Some of the soils in the project area are formed in volcanic extrusive rock. The Waca and McCarthy series are the dominant volcanic-derived soils. The Waca soil is moderately deep and well drained. It has a cobbly sandy loam surface layer over a very cobbly sandy loam subsurface.

The McCarthy series is moderately deep and well drained. It has a gravelly sandy loam surface over very gravelly loam subsoil. Both soils have relatively high organic matter contents and rock fragment contents as influenced by their volcanic parent materials.

Soils Developed from Gabbroic Materials

Some of the soils found in the project area are formed in gabbro, an intrusive igneous rock. The Holland series is the dominant gabbro derived soil. The Holland series is very deep and well drained, and has loam and sandy loam textures throughout the soil profile.

Existing Soil Cover Conditions

The 2004 Freds Fire initially reduced ground cover immediately following the fire to an average 9 percent in high severity burned areas and 17 percent in moderate severity burned areas. The prospective soil cover after needlecast following the fire was estimated during the post fire field work based on the existing brown needles on the trees. The average projected ground cover with needle cast was 19 percent cover in high severity burns and 46 percent in moderate severity burns. Natural vegetative recovery has increased cover with resprouting of some brush and trees species, regrowth of bear clover over significant areas, and growth of grass and forbs. Salvage harvesting in 2005 and 2006 further modified conditions, roughening the surface and loosening soils, laying down skid trails, and adding slash cover from tops and limbs. The target ground cover for the salvage harvest was set at 50%.

Existing cover was measured during silvicultural surveys from 2006 to 2008. Data from these surveys show that cover from live vegetation increased to an average of 60-65 percent by 2007-2008. Ground cover including duff, litter, slash, and rock fragments increases cover, with overlap between the layers. By the time of the first herbicide application, soil cover will consist of dead vegetative cover of grasses, forbs, dead leaves from shrubs, duff and litter that survived the fire, needlecast, harvest slash, and rock fragments. Average soil cover at that point is projected at 70 to 80 percent.

Erosion Risk

This project will potentially affect the soil erosion risk in the short term by both the clearing planting circles and reducing vegetative growth through herbicide use. The risk can be evaluated in the consideration of erosion factors and the general erosion hazard in the project area. The Revised Universal Soil Loss Equation, a common method of assessing erosion hazard, uses five factors in assessing erosion risk: rainfall erosivity, soil erodibility, slope steepness, slope length, and soil cover.

Rainfall erosivity on the west slope of the Sierras ranges from relative values of 80 at a 3000 foot elevation to 10 in the high country, and in the project area varies from around 40 at the lower elevations to 10 at the ridge top elevations where more of the precipitation is snowfall. Rainfall erosivity varies according to the form of precipitation (rain or snow), storm intensity, and total annual precipitation. Total precipitation (rainfall and snow) in the project area is in the 47 to 51 inch range. The 2 year 6 hour storm is about 2 inches.

Soil erodibility is a measure of soil susceptibility to erosion and is given as the soil k factor. The k factor values for the surface horizons of major soils in the burned area are as follows: Holland (0.32), Chaix (0.24), Pilliken (0.20), Waca (0.17), Windy (0.17), Cohasset (0.17), and McCarthy (0.10). The soil erodibility is proportional to the k factor value with Holland at 0.32 as more erodible and McCarthy at 0.10 as least erodible. The soils developed from igneous parent material (Holland, Chaix, and Pilliken) have the greater erodibility. The soils with volcanic parent material and a sandy loam texture are less erodible.

The slope steepness and slope length erosion factors are interrelated. The product of these factors ranges from 6.7 at 70 percent slope to 1.0 at 10 percent slope, assuming a 50-foot slope length and using the Revised Universal Soil Loss Equation slope factor equations. Thus, the Revised Universal Soil Loss Equation predicts a six-fold increase in erosion as slope increases from 10 to 70 percent assuming everything else equal.

The soil cover factor varies in the project area as a function of burn severity, vegetative recovery, timber harvest method, and fuel treatment. High burn severity decreased cover and often delays the vegetative recovery. Harvest method has affected cover. The steeper slopes harvested by helicopter have higher residual cover from limbs and branches than tractor-harvested areas. Some vegetation recovers fast, where bear clover is present there is fast vegetative recovery and nearly 100% cover two years after the fire. The proposed project would modify the soil cover mainly by reducing vegetative regrowth as a result of herbicide use, and potentially reducing plant litter and soil cover in subsequent year.

Environmental Consequences

Alternative 1 (Proposed Action)

Effects of Herbicide Use

The proposed herbicide characteristics vary, particularly in their soil binding coefficient and movement ratings (an adjective ranking, based on pesticide persistence and sorption in soil) The herbicide proposed for widest use, glyphosate, has a very high soil adsorption coefficient, a very low pesticide movement rating, and therefore a low risk of delivery to surface waters. Hexazinone has a low soil adsorption coefficients and very high movement rating. Triclopyr BEE has a moderately low soil adsorption coefficient and low movement rating. Clopyralid has a low soil adsorption coefficient and a very high movement rating. Chlorsulfuron has a low soil adsorption coefficient and a high movement rating (Table 3-24).

The very high movement ratings of hexazinone and clopyralid, and the high movement rating for chlorsulfuron do not necessarily imply that there will be delivery to ground or surface waters in detectable amounts. The amount applied, the breakdown of the herbicides between application and precipitation, and streamside buffers ameliorate the potential for delivery. California's dry summer climate means that there is significant breakdown of the chemicals in the time between spring application and fall rains.

The use of these herbicides is not expected to affect soil biology. The herbicides break down or are broken down by soil microbes over time. As described in Busse, et al (2004), "nearly all studies conducted in forest or nursery soils have found no detrimental effects of assorted herbicides on mycorrhizal formation (Smith and Ferry, 1979; Trappe, 1983; Harvey *et al*., 1985, Marks and Becker, 1990; Sidhu and Chakravarty, 1990)". The list of compounds showing no damage to ectomycorrhizal formation in soil include glyphosate, hexazinone, and triclopyr (and others not proposed for use). Busse added., "In comparison, herbicide effects have been limited to pure cultures studies with high herbicide concentrations (Kelley and South, 1980; Chakravarty and Sidhu, 1987; Chakravarty and Chatarpaul, 1990) or pot studies in which inoculated seedlings are grown in artificial media (Chakravarty and Sidhu, 1987; Sidhu and Chakravarty, 1990)."

Glyphosate is readily metabolized by soil bacteria and many species of soil microorganisms can use glyphosate as sole carbon source. While microorganisms have the same pathway as higher plants for the production of aromatic amino acids, and since glyphosate inhibits this pathway, toxicity to microorganisms may be expected and glyphosate has been considered as an antimicrobial agent for human pathogens. Nonetheless, there is very little information suggesting that glyphosate will be harmful to soil microorganisms under field conditions and a substantial body of information indicating that glyphosate is likely to enhance or have no effect on soil microorganisms (SERA, 2003a). There were some studies (Sidhu and Chakravarty, 1990) that showed reduced growth and reduced numbers of mycorrhizal infections of pine roots in laboratory experiments with recovery over time. Under field conditions, the same study reported less intense effects, and only at high (4 kg/ha) application rates. It appears that glyphosate effects on microbial populations depend on whether studies are done with laboratory media or with soil media or in field studies. Busse et al. (2001) studied affects of glyphosate under field and laboratory conditions. Under laboratory conditions and using culture media, glyphosate reduced microbial populations and respiration. However, in soil media there was no reduction in respiration and there was instead a stimulation of respiration at high concentrations of glyphosate. The authors conclude that glyphosate applied at recommended field concentrations had no consequential effect on microbial populations of pine plantations.

Little data is available from the Triclopyr Risk Assessment (SERA 2003b) regarding the effects of triclopyr on soil organisms. “Laboratory studies involving responses in artificial growth media suggest that responses in soil microorganisms may be highly variable among species, with growth unaffected at concentrations of up to 1,000 ppm in growth medium, but inhibited in other species in concentrations as low as 0.1 ppm. The applicability of these studies to assessing the risk of soil organisms from exposures to triclopyr in soil is questionable but these are the only data available.” Additionally, “If the laboratory studies are used to characterize risk, transient inhibition in the growth of some bacteria or fungi might be expected. This could result in a shift in the population structure of microbial soil communities but substantial impacts on soil – i.e., gross changes in capacity of soil to support vegetation – do not seem plausible. This is consistent with the field experience in the use of triclopyr to manage vegetation.”

Busse et al (2004) found that triclopyr was not suppressive to ectomycorrhizae formation in a variety of forest soil types.

There have been studies done that deal with the effects of herbicides on mycorrhizae (Chakravarty and Sidhu, 1987) that have shown some short term reductions in mycorrhizae due to high levels of herbicides in the soil profile. The study showed triclopyr to be more toxic to mycorrhizae than glyphosate. The studies have dealt with rather high concentrations of herbicides in the soil profile -- levels that are generally higher than those found in soil monitoring data collected on the ENF within the past few years (USDA 1998a).

Standard laboratory culture bioassays show that hexazinone can inhibit microbial growth (Chakravarty and Chatarpaul 1990; Estok et al. 1989; Litten et al. 1985; Krause 1975; Laatinkainen and Heinonen-Tanski 2002, in SERA, 2005). While artificial media studies can be useful in identifying relative sensitivities among species, the most directly relevant studies are those that follow microbial populations after field applications. Field studies conducted by Chakravarty and Chatarpaul (1990, in SERA, 2005) noted no effects on mixed fungal and bacterial populations after application rates of up to 8 kg/ha (about 7 lbs/acre), more than twice the proposed application rate of this project.

Little data is available from the Clopyralid Risk Assessment (SERA 2004b) regarding the toxicity of clopyralid to terrestrial microorganisms. At concentrations of 1 or 10 ppm soil, clopyralid had no effect on nitrification, nitrogen fixation, or degradation of carbonaceaus material (McCall et al. 1979, in SERA, 2004b). While the available toxicity data on soil organisms are limited to two studies, the projected maximum concentrations of clopyralid in soil from this project are far below potentially toxic levels. The available information on soil organisms does not provide any basis for asserting that adverse effects on soil organisms are plausible.

Limited data are available on the toxicity of chlorsulfuron to soil invertebrates and soil microorganisms. Soil microorganisms do not appear to be sensitive to chlorsulfuron (NOEC (No Observed Effects Concentration) of 10 mg/kg) based on cellulose and protein degradation reported by Rapisarda et al. (1981a, in SERA 2004a). These projected maximum concentrations in soil from this project are far below concentrations that appear to be toxic. Thus, there is no basis for asserting that chlorsulfuron is likely to cause adverse effects in soil microorganisms under from project applications.

Table 3-24. Soil Adsorption and Persistence Characteristics for Herbicides

Common Name [1]	Pesticide Movement Rating	Sorption Coefficient (K_{oc})	Persistence
Chlorsulfuron	High	40	Moderately persistent
Clopyralid	Very High	6	Moderately persistent
Glyphosate	Extremely Low	24,000	Moderately persistent
Hexazinone	Very High	54	Moderately persistent
Triclopyr ester (BEE)	Low	780	Moderately persistent

Source: P.A. Vogue, E.A. Kerle, and J.J. Jenkins. The Oregon State University Extension Pesticide Properties Database http://ace.orst.edu/info/npic/ppdmove.htm

Analysis and Soil Quality Standards

The effects of a project on soils can be evaluated in terms of the Soil Quality Standards of Forest Service Region 5 (FSH R5 Supplement No. 2509.18-95-1). The standards define desirable conditions for soil characteristics and threshold levels of detrimental soil disturbance that may result in reductions in soil productivity, soil hydrologic function, and soil environmental health. The soil characteristics are: 1) soil cover, 2) soil porosity 3) organic matter content, including soil organic matter and large woody material, 4) soil hydrologic function and soil buffering capacity. The Eldorado National Forest Land Management Plan directs that no more than 15% of a unit should be detrimentally disturbed. Potential actions that could affect soil quality include clearing planting spots to mineral soil prior to planting each tree, herbicide use in the first year to control competing vegetation, follow-up herbicide use, and mastication of shrubs.

Soil Cover and Soil Loss: The soil loss standard requires the maintenance of sufficient soil cover to avoid detrimental accelerated erosion. Herbicide use has the potential effect of reducing soil cover. There would also be some effect on cover because of the scalping of planting circles (14” – 24” diameter).

Soil Porosity: The soil standard requires maintenance of soil porosity with no more than a 10% loss. The traffic of masticating equipment has some potential for decreasing porosity.

Soil Organic Matter: The standard for organic matter requires maintenance of amounts of organic matter sufficient to prevent significant short or long-term nutrient cycle deficits, and to avoid detrimental physical or biological soil conditions. The proposed project could affect organic matter as a result of herbicide use which would decrease vegetative growth for one season with glyphosate, triclopyr, clopyralid, or chlorsulfuron, and with some residual effects for two to three years with hexazinone.

Soil Hydrologic Function: The standards provide for maintenance of soil hydrologic function. The cleared planting circles around trees would have a small effect on infiltration within the circle. Infiltration may be affected at the scale of the planting circle, but should not be affected at the landscape scale. Masticating equipment use at five to ten years would also have an effect on porosity. Ameliorating factors include the high permeability of the project soils, the low rainfall energy, and the capacity for infiltration outside the planting circles. The small increase in runoff from the planting circles should infiltrate in the matrix so that total runoff at the project site scale is not expected to increase. There is potential for planting circles to intercept concentrated flows from road or skid trail drainage.

Cumulative Effects: Cumulative effects for soils could include the impacts of the proposed project combined with the following past, present, and foreseeable future actions and events: soil disturbance and compaction from past management activities, the Freds Fire, fire suppression activities, salvage harvest, reforestation, and the affect of runoff from roads and skid trails on soil productivity in the project area. The actions were selected because they have caused or have the potential to cause changes in soil quality with ultimate effects on soil productivity. The geographic scope of the cumulative effects analysis is the project area, because impacts to soils accumulate at a given location on the ground, irrespective of actions in surrounding areas. The temporal scope was selected to include impacts to soils that can accumulate over time, considering also the natural recovery rate from impacts.

Direct and Indirect Effects

Soil Cover and Soil Loss: The proposed herbicide use would decrease vegetative growth of grasses, forbs, and shrubs for up to two herbicide treatments. As was determined in silvicultural field surveys, existing vegetative cover in 2007-2008 was averaging 60-65 percent. This did not include duff, litter, slash from timber harvest, and rock fragments. There would be some additional fresh growth of annuals before herbicide application.

Based on the existing vegetative cover, the other components of cover, and expected growth, the average cover of each unit is reasonably projected to be 70 to 80% in 2009. On steeper units where soil cover is more important, there is more slash cover on the ground because helicopter harvesting did not remove as much of the tops and limbs as did ground harvest on lower slopes. The steeper slopes are therefore more protected than the average.

Based on the current cover and growth projections, soil cover should be sufficient to meet soil quality standards and protect against soil loss. Existing ground cover (litter and duff) could be reduced slightly if shrub canopy is reduced but would continue to provide an adequate amount of ground cover. Vegetative killed by herbicides would continue to provide a canopy cover until the leaves fall. Leaf fall would add to the existing ground cover. Project design criteria moreover call for the retention of 75% cover within 100 feet of perennial streams.

Monitoring efforts addressing soil concerns for accelerated erosion and herbicide persistence has taken place on previously implemented herbicide treatment projects in 1991 to 1996. The results of these monitoring efforts are summarized in the following discussion:

In the fall of 1992, a Forest-wide soil quality monitoring effort showed that soil cover standards are being met on 91 percent of the treatment areas monitored (Soil Quality Standards Monitoring-Results for 1992 Field Season-Eldorado National Forest). Additional soil cover monitoring on 1991 and 1992 herbicide-treated units showed that soil cover is maintained at adequate levels after herbicide treatments to prevent accelerated erosion (USDA 2004a). All units are expected to meet soil cover standards after treatment.

Soil Porosity: There will be no effects to soil porosity from herbicide application based on the use on hand treatments. In year 5, there will be masticating equipment traffic for fuel management on about 388 acres of defense zone near Highway 50. The masticating equipment bearing on the soil would have some affect on porosity. The masticating equipment would operate under soil moisture limitations to prevent compaction (refer to BMP 5-6, Chapter 2). Masticating equipment also operates over previously masticated material and tracks over any point but one or two times. Under these conditions, masticating equipment is not expected to increase compaction on any units to the point of noncompliance with the land management plan standards.

Soil Organic Matter: The application of herbicides would decrease the vegetative growth of grasses, forbs, and shrubs in the short term. There would therefore be a near term reduction in the addition of litter to the soil surface and turnover of plant roots below ground. For forest soils the above ground litter and below ground roots turnover and decay relatively fast without making much of an addition in any year to the total inventory of soil organic matter. The total of soil organic matter is so much greater that two years loss of vegetative growth would not have detectable effects. Fires of course have a larger effect on surface organic matter when they burn off a thick layer of duff and litter, yet this too does not significantly affect the long term inventory of soil organic matter. Herbicide use could cause a short-term decrease in nitrogen fixation by removing N-fixing brush species if present.

Soil Hydrologic Function: Clearing small planting circles would be expected to have an effect on infiltration and soil hydrologic function within the circle itself. The planting circles, because they lie in a mosaic with more soil cover, would not be expected to have an affect on hydrologic function of the project area as a whole.

Cumulative Effects

The project area has been disturbed by the Freds Fire, fire suppression activities, salvage harvest, the affect of runoff from roads and skid trails, and would be affected by the reforestation project. The proposed project together with the effects of past projects is not expected to have a significant cumulative effect on soil productivity in the project area.

Soil cover and surface organic matter have already recovered through needlecast, addition of timber harvest slash, and natural vegetative recovery so that cover is adequate. The proposed project is not expected to change that. Monitoring efforts have shown that soil cover is maintained at adequate levels after herbicide treatments to prevent accelerated erosion.

Soil porosity was not found to be a significantly impacted during analysis for the salvage harvest of the project area (USDA 2005). The proposed planting and ground-based hand herbicide applications will not affect it. The masticating equipment, because it makes few passes over any area and travels over masticated debris, will have negligible effects.

Soil organic matter is a relatively long term and stable resource that would not be affected by the short term modifications to vegetative growth caused by the project.

Soil hydrologic function has been affected by the wildfire and the loss of duff and litter. However, with the naturally high infiltration capacity of the forest soils, the effects of fire are ameliorated to a large degree in 2 or 3 years. Planting, site preparation/release, and mastication should not affect the recovery of the site hydrologic function.

Short persistence times of glyphosate and clopyralid would prevent the accumulation of these chemicals in the soil profile from repeated treatments. Persistence monitoring has shown that glyphosate persistence is similar to the information disclosed in the Regional FEIS (USDA 1989b). Persistence of clopyralid is soil is variable with documented half-lives ranging from 10 days to 10 months depending on soil type and climate. Although clopyralid does not bind readily to soil, it dissipates rapidly in some common soil conditions and typically is not expected to leach appreciably in non-sandy, low-to-moderate rainfall conditions. Relatively short persistence times of hexazinone in the soil profile, combined with the lack of repeat hexazinone treatment would prevent the accumulation of hexazinone in the soil profile. Hexazinone can persist for months in soil, ground water and streams in detectable concentrations. Soil and aquatic metabolism produces several metabolites. The limited available information on the environmental fate of metabolites of hexazinone suggest that their disposition parallels that of hexazinone. Hexazinone is mobile in most soils and can leach to depths approximating one meter under heavy rainfall conditions

Alternative 2 (No Action)

Direct and Indirect Effects

Taking no action would not have direct effects on the soils and soil quality. There would be more vegetative growth under this alternative than under Alternative 1 during the years of herbicide use under Alternative 1. In the longer term, vegetation would fill in to occupy the site, and there would be more shrubs and less tree growth than in Alternative 1. Soil cover would be somewhat higher under Alternative 2 than in Alternative 1 during the years of herbicide use. Soil porosity would be similar under Alternatives 1 and 2. Soil organic matter, a long term resource, would be similar under Alternatives 1 and 2. Soil hydrologic function would be similar under Alternatives 1 and 2.

Cumulative Effects

Cumulative effects to soil are based on the exiting soil conditions plus the effects of this alternative and any other potential future events or actions. Fires are predicted to return to this landscape every 15-30 years. In event of another fire, the consequences of this alternative is that the higher fuel levels conditions (grass in the early year and brush in the later year) created will produce flame length, rate of spread and fireline intensity that are higher than Alternative 1. A reburn of the fire would cause the lost of the existing groundcover over a larger area and the potential for accelerated erosion will increase. A high percentage of the down woody material remaining on the site will be consumed and effective ground cover and soil organic materials (downed logs) will be lost.

Alternative 3

Direct and Indirect Effects

Soil Cover and Soil Loss: Soil cover and soil loss would be expected to be similar to Alternative 1. For this alternative, hand cutting and grubbing would clear a 4-5’ radius around each planting group of 2 or 3 trees, 151 groups per acre, with about 27% of each acre cleared. There would be more disturbance and removal of cover in a planting circle in Alternative 3, but no disturbance by herbicide and therefore more vegetation and cover in the matrix on the remaining 73% of the surface area. On the scale of several planting circles or an acre or a unit, this alternative should be comparable to Alternative 1 in terms of cover and soil loss, and no significant differences or negative effects are expected of either.

Soil Porosity: Masticating would occur as in Alternative 1. As in Alternative 1, no detrimental effects on soil porosity are predicted.

Soil Organic Matter: Soil organic matter would be disturbed and redistributed in the process of scalping the planting circles and this would occur over the multiple repetitions of scalping. Surface organic matter would not, however, be moved offsite, and would be available for maintaining overall site productivity. The scalping would reduce vegetative growth in the planting circle as much as in Alternative 1, but in the matrix there would be less or no effect on vegetative growth. The matrix would therefore in the short term produce more duff and litter, but over the course of a few years the difference would be minor.

Soil Hydrologic Function: Clearing the 4-5 foot radius planting circles, amounting to about 27% of the area, would be expected to have an effect on infiltration and soil hydrologic function within the circle itself. The planting circles, because they lie in a mosaic with more soil cover, would not be expected to have an effect on hydrologic function of the project area as a whole. The effects of Alternative 3 should be minimal and similar to Alternative 1.

Cumulative Effects

The cumulative effects of Alternative 3 on soil processes would be expected to be similar to Alternative 1, excepting the 800 acres that would not be planted under Alternative 3. This alternative would result higher fuel levels conditions, similar to Alternative 2. In the event of wildfire, the effects would be similar to Alternative 2.

Hydrology and Watershed Resources

Affected Environment

Most of the project area occurs in the 7th field watersheds of Fry Creek and Kyburz. Streams in the project area in these two watersheds flow to the south and into the South Fork American River (Figure 3-10). The landscape of the project area mostly consists of steep, south-facing slopes. Three recent events have influenced the current appearance and hydrologic function of the landscape in the project area.

The Freds Fire of October 2004. Prior to the Freds Fire, much of the project area was covered with a pine-dominated conifer forest. The Freds Fire burned approximately 69 percent of the project area at a high and/or moderate severity. The riparian areas of a number of perennial streams, such as those in the vicinity of Granite Springs and the town of Kyburz, were largely consumed by the fire. The riparian areas of other perennial streams, such as Fry Creek and its tributaries, were mostly not burned or burned at a low severity.

Salvage logging in 2005. On both NFS and private land, most of the areas burned at a high and moderate severity by the Freds Fire were salvage logged in 2005. Most of the fire-killed trees were removed within 25 feet of perennial streams. For seasonally flowing streams, most of the fire-killed trees were removed up to edge of the channel.

The wet winter of 2005 and spring of 2006. Approximately 80 to 100 inches of precipitation fell on the project area in the seven month period between November 2005 and May 2006; this is nearly 150 percent of the long-term average annual precipitation.

Many of the streams in the project area have experienced some degree of channel erosion and deposition of fine-grained material since the Freds Fire. These impacts are not unexpected, given that erosion rates following a large wildfire are often several orders of magnitude greater than pre-fire erosion rates (Robichaud and Brown 1999; Dissmeyer 2000). In addition, erosion rates in the project area are still high and probably have not returned to pre-fire levels. This conclusion is supported by the high levels of turbidity (Table 3-27) of several streams - particularly Granite Springs Creek and Fry Creek - during the rain event of March 3, 2009. Turbidity is frequently used to make qualitative inferences concerning the amount of sediment being transported by streams and the erosion of the surrounding landscape.

Several of the perennial streams in the project area have more vegetation bordering these streams than in 2005/2006 and active channel erosion is less obvious. This is particularly evident for several streams on the north side of the town of Kyburz.

Physical characteristics of the project area are summarized in Tables 3-25, 3-26, and 3-27. Photographs of the landscape and aquatic features are shown in Figures 3-11 through 3-14. The turbidity of streams is illustrated in Figures 3-15 through 3-17. Additional water quality information is in Appendix C. Appendix C includes:

- Characteristics of the herbicides.
- Water quality standards and objectives.
- Monitoring Plan.
- Best Management Practices.
- Summary from herbicide monitoring report, Stanislaus National Forest.
- Summary of herbicide monitoring, Eldorado National Forest.
- Turbidity data for streams in the Freds Fire Reforestation project area.

Figure 3-10. Watersheds and Aquatic Features in the Vicinity of the Freds Reforestation Proje

Table 3-25. Physical Characteristics of the Freds Fire Reforestation Project Area.

Watersheds	Most of the project area is located in two 7th field watersheds: Fry Creek (7,842 acres) and Kyburz (6,748 acres). A small portion of the project area is in the Junction Reservoir 7th field watershed (11,520 acres). The watersheds are a mixture of National Forest and private land. 8th field watersheds (contained within the 7th field watersheds) include East Kyburz Cr. (1025 acres), West Kyburz Cr. (389 acres), Granite Springs Cr. (867 acres) and Fry Cr. (1288 acres).
Climate	Average annual precipitation ranges between 45 inches at lower elevations (falling mostly as rain and snow) to 65 inches at higher elevations (falling mostly as snow). Most of the precipitation falls between October and April, although localized thunderstorms can occur in the summer. In the winter, rain-on-snow events can occur. The 24-hour storm event for 2, 10, 25, and 100 years is 4.6, 7.3, 9.1, and 11.0 inches, respectively.
Streams and aquatic features[1]	There are 10 known perennial streams in the project area with a total length of 3.7 miles. The riparian areas adjacent to the perennial streams are fairly narrow, but a number of these riparian areas contain abundant vegetation. The flow of the perennial streams is not regulated, and the baseflow of these streams ranges between 0.1 and 1.0 cubic feet per second (cfs.). Water quality during baseflow conditions appears to be good - pH ranged between 7.1 and 7.9 (slightly alkaline), electrical conductivity ranged between 86 and 205 uS/cm (fairly low dissolved solids), and turbidity is less than 5 NTU (clear water - low sediment load).[1] Several perennial streams transport considerably more sediment during storm events than during baseflow conditions (Figure 3-15). Three wet meadow/spring areas, which total 16.8 acres, are located near Granite Springs and the headwaters of Fry Creek. These wet areas are vegetated with willow and cattails. Nearly all of the streams flow to the south and into the South Fork American River. Nearly all of the streams are non-sinuous. This means that the channel has little or no meandering and water flows in nearly a straight line. Most of the streams have a gradient greater than 4 percent and some stream segments have a gradient of greater than 10 percent. This means that these streams do not store sediment in channels and floodplains, but rather transport sediment quickly to the South Fork American River during large storm events. The structure of channels is largely controlled by boulders and cobbles, although outcrops of bedrock occur at a few locations. This means that vertical and lateral erosion of the stream channel can occur - all of the surveyed streams show recent evidence of such.
Beneficial uses of water	Beneficial uses of water (as designated by the Central Valley Regional Water Quality Control Board) include: water supplies for domestic, municipal, industrial, and agricultural use; hydroelectricity; contact and non-contact recreation; coldwater fish; and wildlife. The Kyburz Mutual Water Company has a water right on two perennial streams - East Kyburz Creek and West Kyburz Creek - in order to supply drinking water to approximately 115 residences in Kyburz. The Kyburz Mutual Water Company is currently only diverting water from East Kyburz Creek, but could also divert water West Kyburz Creek as needed. Water is withdrawn from Granite Springs Creek for the 29 milestone summer home tract. The El Dorado Irrigation District uses water from the South Fork American River to supply much of El Dorado County with its drinking water supply. Pacific Gas and Electric (PG&E), Sacramento Municipal Utility District, and El Dorado Irrigation District utilize water from the South Fork American River for hydroelectric power generation.
Aquatic life	There are no known fish or sensitive amphibian species present within the fire area. Streams are habitat for aquatic macro invertebrate species as well as common amphibians such as tree frogs. Refer to the Aquatic Biology Section for additional information.
Geology	Intrusive igneous rocks - quartz granodiorite, granodiorite, diorite, and gabbro - are exposed at the surface throughout much of the project area. The approximate age is 60 to 100 million years. Extrusive igneous rocks - volcanic mudflows - are found along Peavine Ridge and Atherton Flat. These are the youngest rocks in project area, 2 to 24 million years old. Metamorphic rocks - primarily slate - are found in the western margin of the project area. These are the oldest rocks of the project area, 345 to 500 million years old, and were formed by contact metamorphism when molten igneous rock intruded into older sedimentary rock. Landslides (both deep and shallow) and debris flows occur in the project area.

[1] Additional information on water quality is in Appendix C.

Figure 3-11. Landscape at Granite Springs, Shortly after Salvage Logging. ***May 2005.***

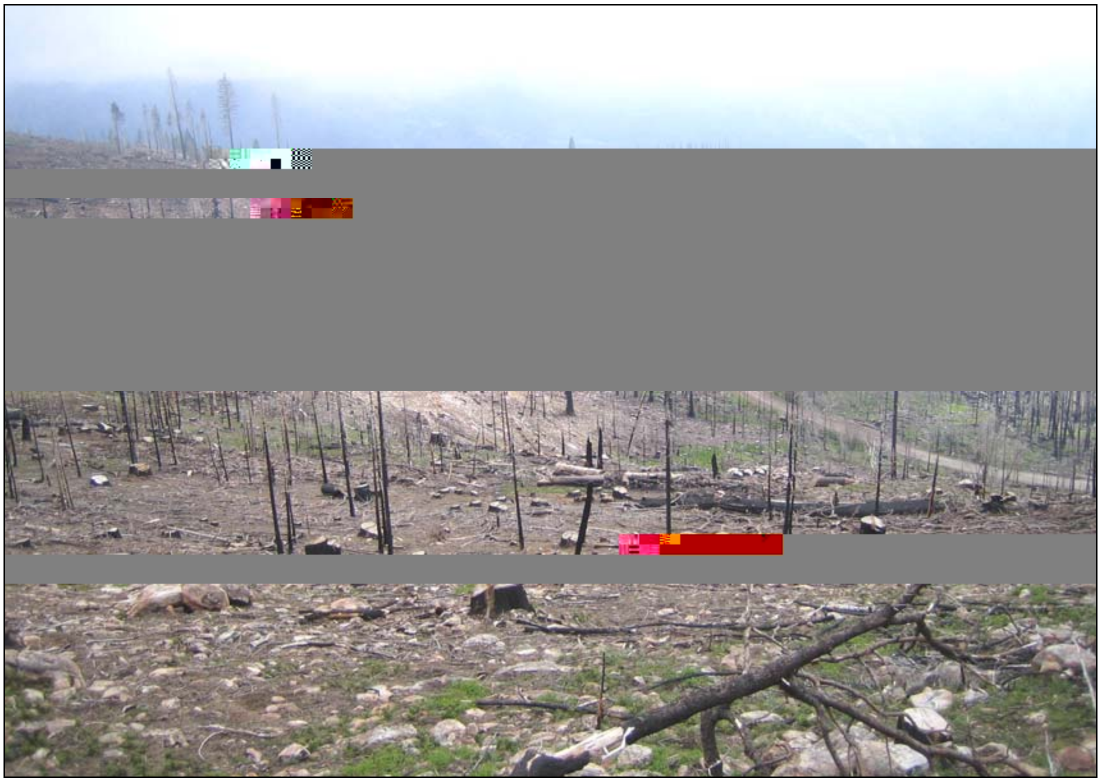


Figure 3-12. Landscape at the Headwaters of Fry Creek. ***July 2006.***

Table 3-26. Summary of Selected Aquatic Features in the Freds Fire Reforestation Project Area[1,2,3,4,5,6]

Feature and location	Overall condition	Summary description	Additional comments
Unnamed tributary of Fry Creek 0.4 miles east of road 11N38E.	Good	Stream channel is in the process of recovering from past land disturbances (predominately fire and logging). Abundant riparian vegetation has stabilized eroded stream channel and created a cool microclimate next to the stream.	Stream temperatures of 54 - 56^{o} F even when upland air temperatures exceed 85^{o} F.
Fry Creek at road 11N38 (Weber Mill Road)	Good		
Meadow near road 11N42D	Very good	Abundant riparian vegetation (willow, cattails) with wet soils, areas of standing water, and no visible evidence of surface disturbance.	Entire meadow (600 feet in length) sits in the sun - no shading by trees.
Granite Springs Creek	Fair	Streams have not recovered from past land disturbances (predominately fire and salvage logging). Segments of the stream channel are still actively eroding and contain abundant fine-grained material and or sand/gravel. Riparian vegetation and large woody debris is present, but is less abundant than in other streams in the surveyed area where the stream channels are stable.	Summer stream temperature of 62 to 65^{o}F is approximately 10^{o}F warmer than Fry Creek and its tributaries.
East Kyburz Creek	Fair		Source of drinking water for the town of Kyburz.
Unnamed stream near road 11N99F	Fair		

[1] All features occur on south-facing slopes.
[2] All surveyed streams are perennial; the baseflow of each stream is between 0.1 and 1.0 cubic feet per second.
[3] The channels of the surveyed stream segments are mostly controlled by boulders and cobbles.
[4] The overall condition is based on ratings/measurements of a number of parameters of the aquatic feature and its adjacent Riparian Conservation Area. None of the streams were given an overall condition *very good* or *poor*. For a stream, an overall condition of *very good* would require little or no recent evidence of channel erosion or instability (none of the surveyed streams are naturally unstable). An overall condition of *poor* would require that little or no riparian vegetation exists in a stream channel where abundant riparian vegetation should exist (none of the surveyed streams are naturally devoid of riparian vegetation).
[5] The condition of aquatic features was initially surveyed in July/August 2006. Approximately 50 percent of the surveyed stream segments contained one or more of the following to some degree: active downcutting of the channel, sheet erosion, rill erosion, and headcuts. A field visit to the area in February 2009 showed that the condition of streams was similar to the initial survey in 2006. However, several of the perennial streams in the project area have more vegetation bordering these streams in 2009 than in 2005/2006 and active channel erosion is less obvious. This is particularly the case for several streams on the north side of the town of Kyburz.
[6] Small slope failures and other erosional features are prevalent throughout the project area.

Figure 3-13. East Kyburz Creek (lower left of photo). ***February 2009.***

Figure 3-14. Wet Meadow (middle of photo) near the Headwaters of Fry Creek. ***August 2006.***

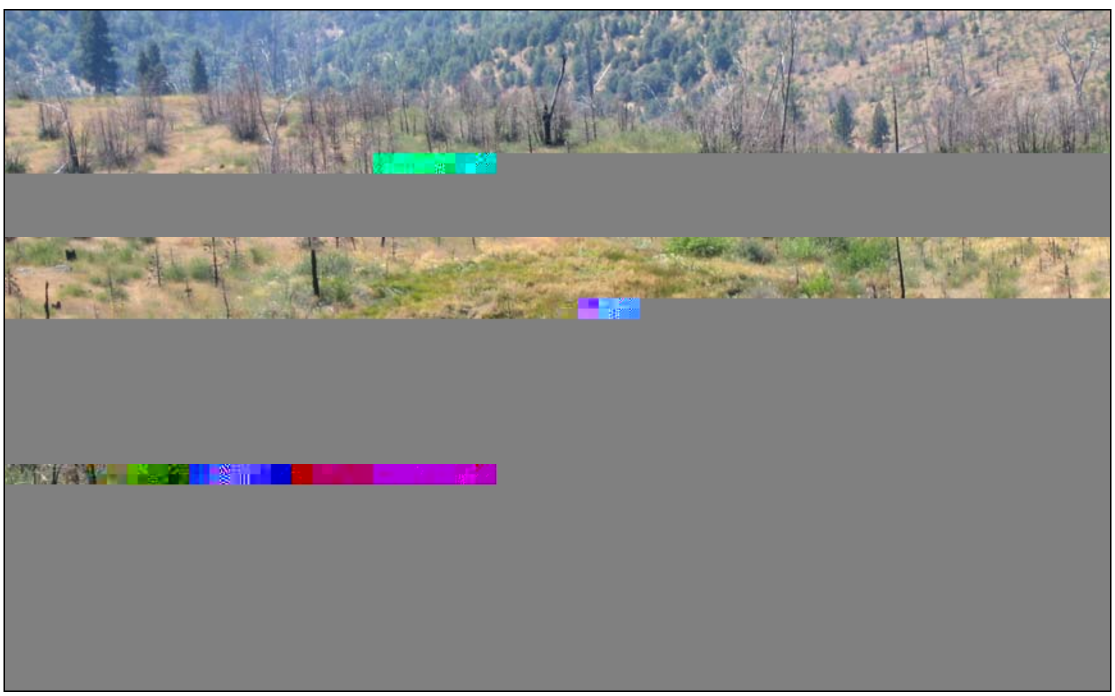
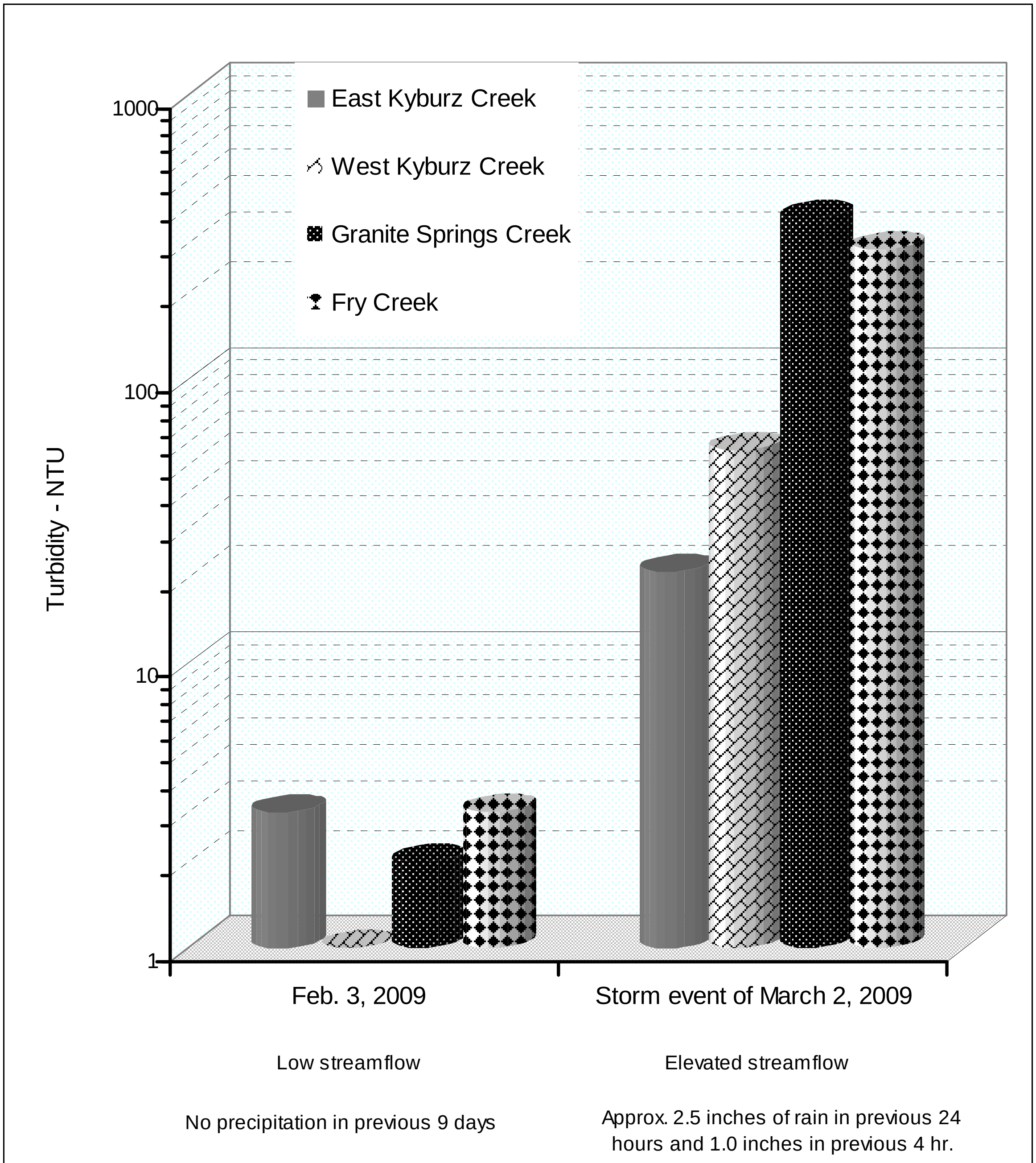


Figure 3-15. Turbidity of four Streams in the Freds Fire Reforestation Project Area.[1,2,3]



[1] Turbidity is a numerical measure of the clarity (or cloudiness) of water, and is frequently used to make qualitative inferences concerning the amount of sediment being transported by streams and the erosion of the surrounding landscape. Turbidity is measured in Nephelometric Turbidity Units (NTU).

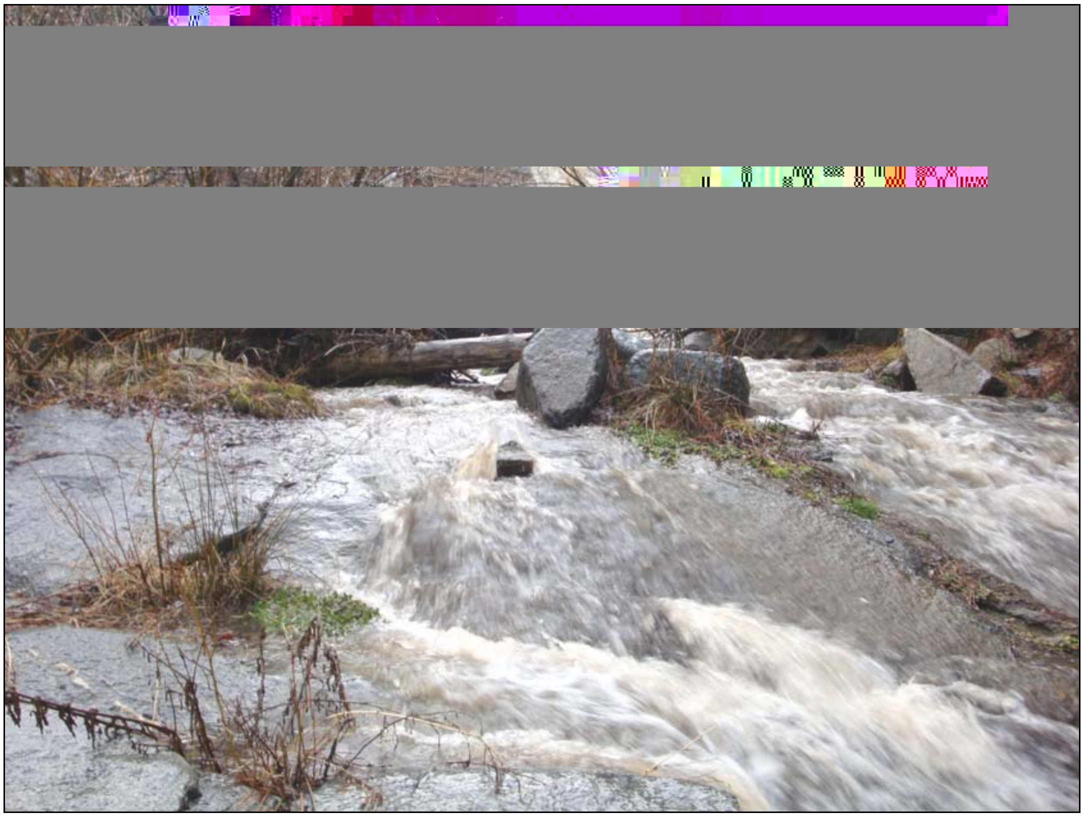
[2] During the storm event of March 2 of 2009, all of the precipitation in the Freds Fire area fell as rain - the snow level was greater than 6,000 feet.

[3] Note that the vertical scale is logarithmic, not arithmetic.

Figure 3-16. Turbidity of Streams in the Freds Fire Reforestation project area on March 2, 2009. (NTU = Nephelometric Turbidity Units).

0.1 NTU	**21** NTU	**56** NTU	**285** NTU	**365** NTU
Drinking water from a residence as a comparison.	East Kyburz Creek	West Kyburz Creek	Fry Creek	Granite Springs Creek
	Approximately 2.5 inches of rain fell in the 24-hour period prior to the turbidity measurements of March 2, 2009. The turbidity measurements were taken on the rising limb of the hydrograph - just before the peak - and all streams in the project area were flowing vigorously. Approximately 1.0 inches of rain fell in the 4-hour period prior to the turbidity measurements, and it was raining hard during the measurements and for several hours afterwards. The snow level was greater than 6,000 feet - all of the precipitation fell as rain in the contributing drainage areas.			

Figure 3-17. Fry Creek during the Storm Event of March 2, 2009.



Environmental Consequences

Effects Common to All Alternatives

Direct and Indirect Effects

The use of streams as a source of drinking water will not be adversely affected. The reasons for this conclusion are different for each alternative, and are discussed in detail in the sub-sections for each alternative. Other beneficial uses of water, such as for aquatic wildlife and terrestrial wildlife, are addressed in other sections in Chapter 3.

Sediment delivery to streams, turbidity levels of streams, and the rate of the recovery of degraded stream channels is similar for all the alternatives - both in the short-term (less than 10 years) and the long-term (greater than 10 years). There are three major reasons for this conclusion.

Over four years have passed since the Freds Fire of October 2004. The available research indicates that erosion rates commonly decrease several orders of magnitude within four years following a large wildfire (Figure 3-18), and that it may take more than 10 years for erosion rates and sediment delivery to streams to return to pre-fire levels (Dissmeyer 2000). This is likely to be the case under all the alternatives. It should be noted that erosion rates in the project area currently high - particularly in the 8th field watersheds that contain Fry Creek and Granite Springs Creek - as indicated by the turbidity levels of streams during a recent large rainfall event.

The design criteria under Alternative 1 (Proposed Action) creates “buffer zones” next to streams and aquatic features where there is no herbicide spraying, limited herbicide spraying, and ground cover requirements. The available research indicates that "buffer zones" next to aquatic features greatly reduces the amount of sediment reaching those features (Parkyn 2004; Dissmeyer 2000).

Several of the perennial streams in the project area have shown noticeable recovery as of February 2009. Vegetation bordering these streams is thicker and active channel erosion is less obvious than in 2005.

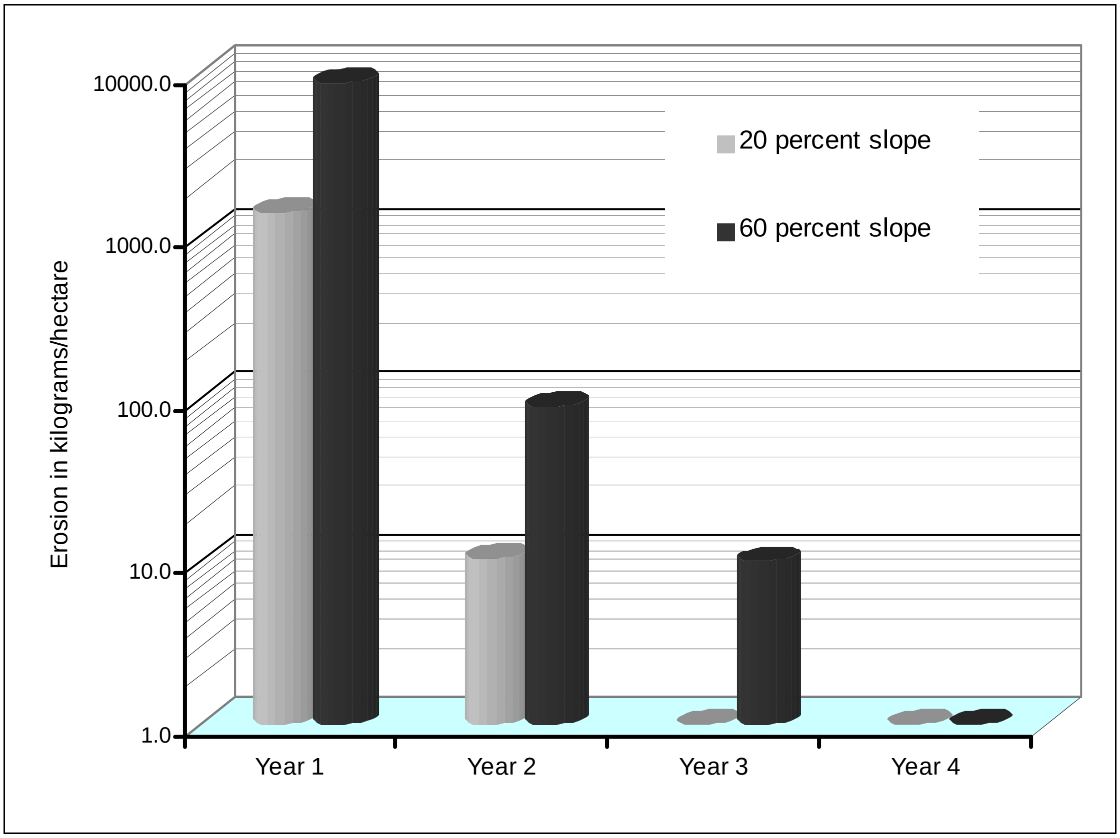
The total water yield from the project area may decrease slightly in the long-term (starting in 20 to 30 years) as trees near streams consume ground-water that would otherwise reach stream channels. This would likely result in a slight reduction in the flow of streams and the size of meadows. This means that the amount of water available for all beneficial uses would be slightly less than at the present time, assuming no long-term changes in the amount of precipitation. There are two reasons for the above conclusions.

The research has generally shown that water yield in upland coniferous forests decreases by 1.5 to 2.0 percent for every 10 percent of a watershed that is afforested (Cannell 1999), and also that water yield starts to decrease in 20 to 30 years after the planting of conifers (Dunne and Leopold 1978).

Approximately 29 percent of the project area would be planted with conifers under Alternatives 1 and 3. Even if Alternative 2 (No Action) is selected, approximately 41 percent of the project area in the ENF has already been planted with conifers.

In the long-term (greater than 10 years), the temperature of perennial streams may decrease slightly in the summer as growing conifers provide additional shade to the surface of streams. It should be noted, however, that a number of the perennial streams in the project area are currently well-shaded by existing vegetation. This suggests that any reductions in stream temperature would at most be minor. Table 3-28 summarizes the Likely Direct/Indirect impacts to Hydrology and Watershed Resources for each alternative.

Figure 3-18. Erosion rates following a wildfire in eastern Oregon (Robichaud and Brown 1999).



NOTE: Erosion rates represent hillslope erosion, not the amount of sediment delivered to streams. The vertical scale is logarithmic – erosion decreased three orders of magnitude between year 1 and year 4 after the fire.

Table 3-28. Summary of the Likely Direct/Indirect Impacts to Hydrology and Watershed Resources for each Alternative.[1,2]

	Alternative 2 - No Action (Natural recovery - no planting of conifers; no release) **Alternative 3** (Planting of conifers; no use of herbicides)	**Alternative 1 - Proposed Action** (Planting of conifers and use of herbicides)
Beneficial uses of water	Short-term and long-term: The use of streams as a domestic water source will not be adversely affected.[2]	
Herbicide concentrations in streams	Short-term and long-term: There will be no herbicides in streams under Alternatives 2 and 3.	Short-term: Herbicides (and their surfactants and additives) may reach streams under several worse-case scenarios. However, the concentrations would be below Maximum Contaminant Levels for humans. Long-term: No herbicides in streams.
Sediment delivery to streams **Turbidity levels of streams**	Short-term: Similar for all alternatives. Long-term: Negligible difference between the alternatives.	
Temperature of perennial streams	Short-term. No increase or negligible increase under all alternatives. Long-term: No increase under any alternative. Minor decrease may occur under all alternatives.	
Water yield and the flow regime of streams	Short-term: Negligible difference in the flow of streams for all alternatives. Long-term: All alternatives may result in a decrease in the flow of streams - this would likely start in 20 to 30 years. This may occur slightly faster under Alternative 1.	
Meadows	Short-term: Negligible change in the size and wetness of meadows under all alternatives. Long-term: Size and wetness of meadows may decrease slightly in 20 to 30 years under all alternatives.	
Watershed recovery	Short-term: Recovery of degraded stream channels is similar for all alternatives. Long-term: Recovery of degraded stream channels is similar for all alternatives. In terms of restoring the forest, recovery is the slowest under Alt. 2 (No Action), slightly quicker under Alternative 3, and the quickest under Alternative 1 (Proposed Action).	

[1] Short-term impacts are less than 10 years and long-term impacts are greater than 10 years, unless specified otherwise.
[2] Impacts to aquatic species and terrestrial wildlife are addressed in other sections in Chapter 3 of this Final Environmental Impact Statement.

Alternative 1 (Proposed Action)

Two scenarios are considered in order to assess the potential impacts to the domestic use of water as a result of herbicides.

Probable scenario. This is the reasonable expected concentrations of herbicides in a stream or water body that might be encountered following herbicide application.

Worst-case scenarios. This includes a) the spraying or spill of herbicides into a stream or water body, and b) a large thunderstorm that quickly erodes sediment containing herbicides directly into a stream or water body.

Domestic Uses of Water- Town of Kyburz

The only herbicide that will be used near East and West Kyburz Creeks is glyphosate. There is a low risk that glyphosate (including additives and surfactants) will reach East or West Kyburz Creeks. If glyphosate does reach those two streams, the concentrations of the herbicide will be below the Maximum Contaminant Level (MCL) of 700 micrograms per liter (ug/l) or parts per billion (ppb) for human health as established by the EPA (CEPA 2003). The reasons for these conclusions are described below.

Modeling results using the SERA risk assessments - even assuming worse-case conditions - show that the concentration of glyphosate of East and West Kyburz Creeks, as well as all perennial streams in the project area), is less than the MCL of 700 ppb. This is depicted in Figure 3-18 and summarized below.

The modeled concentration of glyphosate decreases to less than 1.0 ppb at a distance of 500 feet downstream of the herbicide application site.

The modeled concentration of glyphosate decreases one order of magnitude as the flow increases from 0.1 to 0.5 cubic feet per second (cfs). A flow of 0.1 cfs represents the lowest measured streamflow of any perennial stream in the project area from 2004 through 2009; several of the streams usually had a baseflow of 0.5 cfs or greater during that time period.

All of the modeled scenarios assume that 10 percent of the length of the streams that border herbicide units are accidentally sprayed with glyphosate at the maximum application rate of 4.7 pounds/acre (i.e. the “no-spray” buffer widths next to streams are not completely implemented and occasional spraying of the stream surface does occur). The SERA risk assessments are discussed in detail in the Site Specific Human Health Risk Assessment (Appendix D).

Monitoring results over the past 15 years consistently show that glyphosate, when applied by ground application, seldom reaches surface water, even with “no spray” buffer widths as narrow as 10 feet (USDA 2001a; Frazier and Grant 2003). This conclusion is based on over 150 samples taken from surface water at many locations in National Forests in California between 1991 and 2002 following the application of glyphosate. The highest concentration of glyphosate measured by the US Forest Service in Region 5 since 1991 was less than 30 ug/L. In addition, approximately 99 percent of the stream samples tested had concentrations less than the laboratory detection limit. The few instances where glyphosate has been detected in surface water have almost always been traced to accidental spills directly into a stream, the intentional spraying of the stream surface, or the spraying of vegetation on the streambank or on gravel bars in the channel (USDA 2001a).

Project design specifies that glyphosate will not be sprayed within 50 feet of the two streams used for the water supply for the town of Kyburz.

The reason that glyphosate is seldom detected in surface water is related to the properties of the herbicide. Glyphosate tends to bind readily and strongly to soil particles and does not leach through most soil types (SERA 1997c). Glyphosate could still reach East and West Kyburz Creeks through erosion - particles of sediment with attached glyphosate being transported into those streams. However, the increase in the amount of sediment delivered to East and West Kyburz Creeks as a result of Alternative 1 (Proposed Action) should be negligible or slight for two reasons.

Within 100 feet of the of the two streams, a minimum of 50% ground cover would be retained through all release treatments, and the existing vegetation within 50 feet of each stream would be completely maintained by the 50 foot wide no herbicide zone.

Any sediment, along with attached glyphosate, should be largely removed from the drinking water at the treatment plant in Kyburz. The water diverted from East and West Kyburz Creeks is sent to a treatment plant and nearly all of the sediment is removed in a multi-step filtration process. Specifically, the water is required by law to have a 30-day average turbidity of less than 1.0 Nephelomentric Turbidity Units (NTU). If the turbidity exceeds 5.0 NTU for more than two consecutive days, the treatment plant automatically shuts down. Turbidity is a relative measure of the clarity (or cloudiness) of water, and water with a turbidity of less than 1.0 NTU is extremely clear and practically devoid of particulate matter.

There are two “worst-case” scenarios - unlikely but possible - where glyphosate would likely reach East and West Kyburz Creeks.

An accidental spill of glyphosate directly into the stream. In such an event, the concentration of glyphosate in the stream could be greater than the MCL of 700 ppb at the spill site. However, the concentration of glyphosate should decrease greatly within 500 feet downstream of the spill site. This conclusion is supported by the modeling results in Figure 3-10. The Best Management Practices (Chapter 2) describe the actions that would be taken in the event of an accidental spill.

A large thunderstorm that directly hits the drainage areas that feed East and West Kyburz Creeks within a few months after herbicide application (the herbicides would be applied in late spring or summer, which typically receives little rainfall); erosion could carry particles of sediment (with glyphosate attached) to the streams. Exacerbating this scenario is that the site conditions next to the two streams at a number of locations are conducive to the transport of sediment to the streams. The soils next to the stream are easily eroded – the slopes are steep (30 to 70 percent) and the soils are primarily granitic in composition. In addition, the slopes of the stream channels themselves are fairly steep (greater than 4 percent) and the travel distance to Kyburz fairly short (less than 1 mile). However, this worst-case “thunderstorm” scenario is largely mitigated by the filtration of the drinking water at the treatment plant as previously described.

There is evidence that suggests that even the two “worse-case” scenarios described above still pose a low risk to water quality. In one extreme simulated worst-case scenario, conducted in western Oregon by the US Geological Survey, runoff from the shoulder of a road sprayed with glyphosate at 1.5 pounds/acre with a rainfall of 0.3 inches/hour for several hours resulted in glyphosate concentrations of 323 to 736 ug/L on the first day of application and 16 to 21 ug/L two weeks after application (Wood 2001). The MCL for glyphosate is 700 ug/L.

Hexazinone will not occur in the two perennial streams - East and West Kyburz Creeks - that serve as the drinking water supply for the town of Kyburz. There are two reasons for this conclusion.

Hexazinone will not be used in the 8th field watershed that contains West Kyburz Creek.

Hexazinone will be used in only 6.5 acres in the 8th field watershed that contains East Kyburz Creek. The area of hexazinone application, which borders the eastern edge of the watershed, is located more than 1,000 feet from the nearest intermittent stream and 4,000 feet from East Kyburz Creek.

Clopyralid will not occur in East and West Kyburz Creeks. This is because clopyralid will not be used in the 8th field watersheds that contain those two streams.

It is unlikely that triclopyr will be detected in East and West Kyburz Creeks. There are two reasons for this conclusion.

Triclopyr will not be used in the 8th field watershed that contains West Kyburz Creek.

Triclopyr will be used in only 20 acres in the 8th field watershed that contains East Kyburz Creek. The area of triclopyr application borders one intermittent stream that drains into West Kyburz Creek. Modeling results using the SERA risk assessments - even assuming worse-case conditions - show a concentration of triclopyr of 0.1 ppb at a distance of 500 feet downstream of herbicide application.[1]

A number of Best Management Practices (Chapter 2) will be employed to minimize degradation of water quality from herbicides and sediment. These BMP's cover the accidental spill of herbicides directly into the stream.

Domestic Use of Water - South Fork American River

Herbicide applications will not impair the South Fork of the American River as a drinking water supply for several reasons.

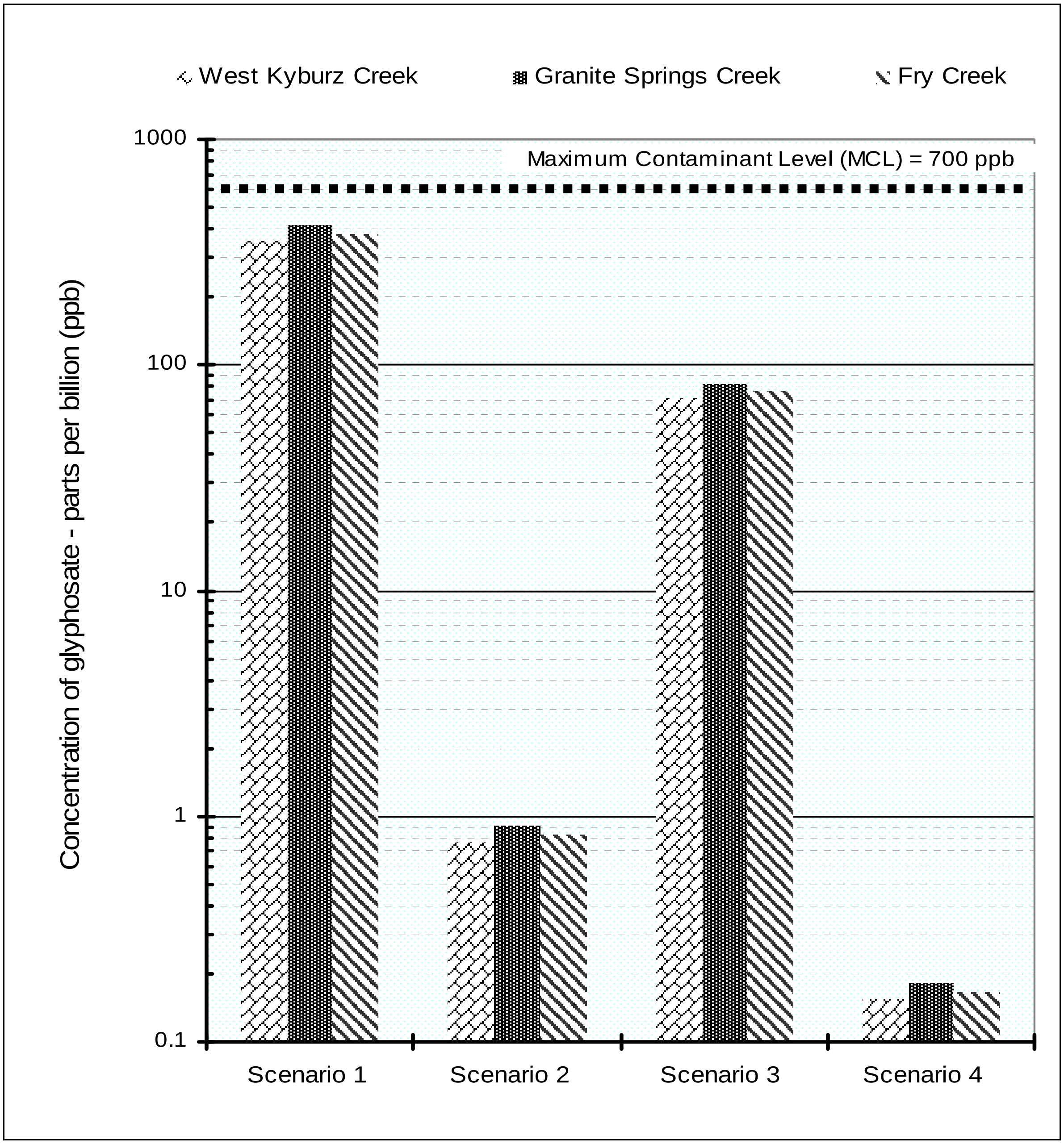
Herbicide monitoring results from over 1,100 water samples in Region 5 of the U.S. Forest Service since 1991 strongly suggests that the application of herbicides - when "no-spray" buffer widths are applied next to streams and other aquatic features - results in either no detection of herbicides in downstream surface water or concentrations far below that known to cause harm to humans (USDA 2001a; Frazier and Grant 2003). This conclusion is well supported for glyphosate, triclopyr, and hexazinone. This conclusion is less certain for clopyralid because of the small amount of monitoring data for that herbicide.

The majority of the areas that will be sprayed with herbicides will be sprayed with glyphosate. Glyphosate binds strongly to most soils types, is fairly non-mobile, and mostly decomposes to its natural components within six months. As a result, monitoring results over the past 15 years consistently show that glyphosate, when applied by ground application, seldom reaches surface water even with "no spray" buffer widths as narrow as 10 feet (USDA 2001a; Frazier and Grant 2003).

For all perennial streams in the project area that drain into the South Fork American River, the modeled concentration of glyphosate decreases to less than 1.0 ppb at a distance of 500 feet downstream of the herbicide application site (Figure 3-10). The South Fork American River ranges between 600 and 5,400 feet from all areas where glyphosate would be used.

[1] The assumptions in the modeling of triclopyr are: a.) 10 percent of the length of the stream that borders the herbicide unit is accidentally sprayed with triclopyr at the maximum application rate of 2.4 pounds/acre (i.e. the "no-spray" buffer widths next to streams are not completely implemented and occasional spraying of the stream surface does occur), and b.) the flow of the stream is 0.05 cubic feet per second.

Figure 3-18. Theoretical Concentration of Glyphosate of Three Perennial Streams.1



Distance downstream	0 **feet**	500 **feet**	0 **feet**	500 **feet**
Streamflow in cubic feet per second (cfs)	0.1	0.1	0.5	0.5

[1] It is assumed than 10 percent of the length of the streams that border herbicide Units is accidentally sprayed with glyphosate at the maximum application rate of 4.7 pounds/acre. The results for West and East Kyburz Creeks are nearly the same. The results for Fry Creek and a perennial tributary of Fry Creek are nearly the same.

The areas that would be sprayed with hexazinone and triclopyr are more than 1,000 feet from the nearest perennial stream and more than 5,000 feet from the South Fork American River. Chlorsulfuron will be applied at only one site - the nearest perennial and seasonal streams are more than 1,500 and 600 feet from the site, respectively.

The flow of the South Fork American River is usually at least one order of magnitude greater than the combined flow of all of the streams from the project area that drain into the South Fork American River. This means that the water quality of the streams that drain into the South Fork American River from the project area would likely have at most a minor effect on the water quality of the South Fork American River itself.

The treatment of invasive plants may introduce a small amount of glyphosate/surfactant into streams at a number of locations. The locations that have been identified thus far include: Fry Creek and two of its tributaries where they cross road 11N38; the unnamed stream draining from Granite Springs where it crosses road 11N38; and a short segment of a perennial tributary of Fry Creek upstream of road 11N38. Based on the existing monitoring results previously described, the likely concentrations of glyphosate in streams would be well below the MCL of 700 ug/L.

In terms of the amount of sediment delivered to streams during storm events and the resulting levels of turbidity and suspended sediment, increases are expected to be negligible or slight and do not pose a risk to the use of water as a drinking water supply. The reasons for this conclusion are discussed below under the heading **Sediment Delivery to Streams**.

Other Beneficial Uses of Water

Two of the beneficial uses of water - recreation and hydropower generation - are located on the South Fork American River outside of the project area. The beneficial uses of water for coldwater fisheries and wildlife are discussed in the sections of this document that pertain to those subjects.

Sediment Delivery to Streams

In the short-term (less than 10 years), there may be a negligible or slight increase in the amount of sediment delivered to streams during and immediately after storm events. All State standards for suspended sediment and turbidity - both narrative and numerical as listed in Appendix C - will be met. There are several reasons for these conclusions.

The total amount of ground disturbance near st

The current amount of sediment delivered to streams during large storm events - which is high as discussed under the

Alternative 2 (No Action) and Alternative 3

The effects are similar to Alternative 1 (Proposed Action), with the following exception: the concentration of herbicides in streams will be zero because no herbicides will be used under Alternatives 2 and 3.

Total water yield - which translates to a decrease in streamflow and the size of meadows - may decrease more slowly under Alternatives 2 and 3 than under Alternative 1 (Proposed Action). This is because Alternatives 2 and 3 will result in a slower regrowth of the forest in the project area than Alternative 1 (Proposed Action). Changes in water yield as a result of the rate of reforestation has been previously discussed under *Effects Common to All Alternatives.*

The risk of a large wildfire in the project area might be greater under Alternatives 2 and 3 than under Alternative 1 (Proposed Action). The potential effects of a large wildfire include a short-term (generally less than five years) degradation of water quality and aquatic habitat in the project area - this in turn can impair downstream beneficial uses of water. The severity and extent of such impacts from large wildfires is highly variable and depends on many factors; some large wildfires result in negligible impacts to water quality, aquatic habitat, and beneficial uses of water.

Cumulative Effects

Background

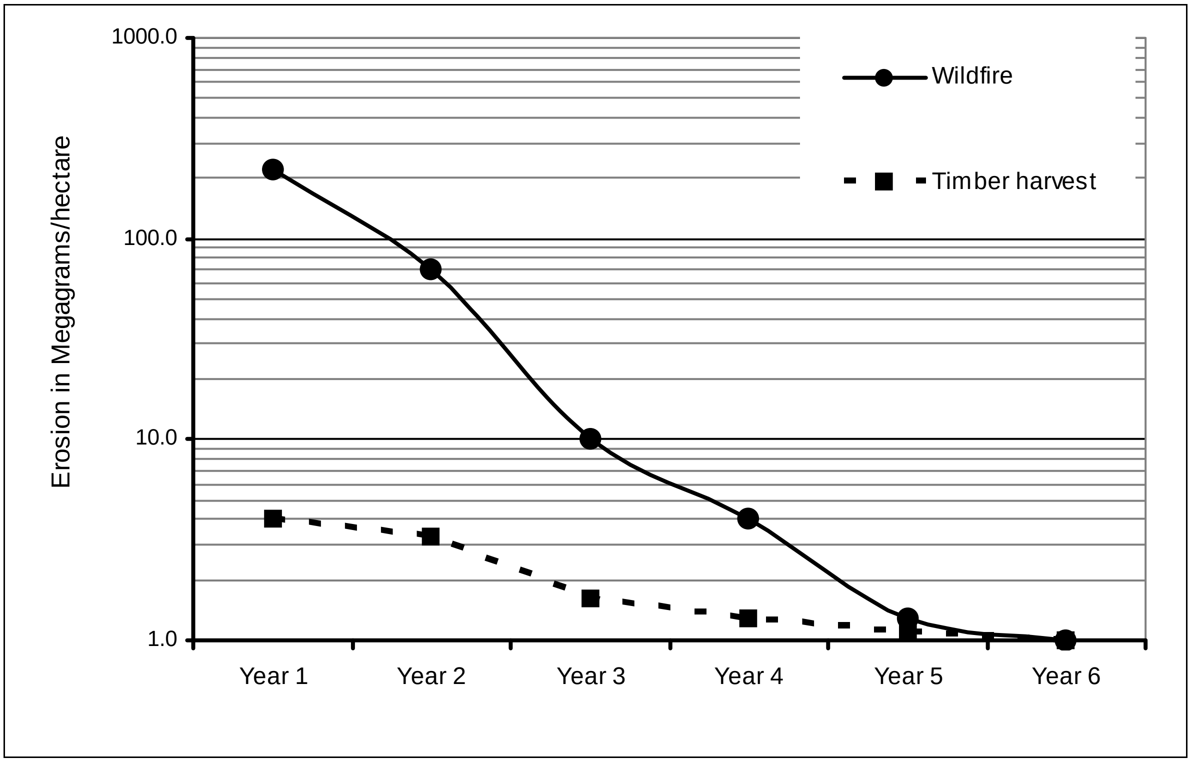
Cumulative watershed effects (CWE) considers all past, present, and likely future land disturbances in a given drainage area. In the ENF, the major potential cumulative watershed effect is the degradation of habitat for aquatic and riparian species. This can result when land disturbances - roads, timber harvest, wildfire, etc. - increase the amount of sediment delivered to aquatic features. The geographic scope of the analysis of cumulative effects includes the three 7th field watersheds that contain the Freds Fire Reforestation project. These 7th field watersheds are: South Fork American River - Kyburz, South Fork American River - Fry Creek, and Junction Reservoir. Most of the project area is contained in the first two watersheds (Figure 3-10).

Cumulative effects have occurred to some degree in all of the surveyed streams in the project area in the form of channel erosion and deposition of fine-grained material since October 2004; this is described in the *Affected Environment*. The two most likely causes of the stream channel degradation are two large recent land disturbances in the project area - the Freds Fire of 2004 and salvage logging in 2005. The research indicates that erosion rates are extremely high for several years following wildfires and then decline dramatically; erosion from timber harvest is less than from wildfires (Figure 3-19). Additional past timber harvest activities may also be a contributing factor to the current stream channel degradation in the project area.

Method

In the ENF, the risk of the occurrence of cumulative watershed effects (CWE) for each 7th field watershed is assigned to one of the following four categories: *low*, *moderate*, *high*, or *very high*. The assignment of the risk of CWE is based on a quantitative evaluation of the land disturbances in the watershed using the method of Equivalent Roaded Acres (ERA). A detailed explanation of the ERA method is contained in Appendix C.

Figure 3-19. Modeled Erosion Rates for a Wildfire and Timber Harvest in the Cascade Range of Western Oregon (Adapted from Elliot and Robichaud 2001).



Limitations

The ERA method, as well as a number of other methods that are commonly used to assess the risk of CWE, contain a number of limitations Most of the methods of analyzing Cumulative Watershed Effects assess the risk of CWE at the watershed scale.

The risk of degradation of habitat for aquatic and riparian is species assessed at the 7th field watershed scale. Most of the 7th field watersheds in the ENF are between 2,000 and 15,000 acres in size.

The risk of CWE at the 7th field watershed scale may or may not reflect the risk of CWE of an individual aquatic feature. For example, the risk of CWE of a watershed may be *low* or *moderate*, but the risk of CWE of a specific segment of a stream in the same watershed may be *very high* as a result of several types of disturbances next to that one stream segment.

The method cannot quantitatively predict the amount of sediment delivered to streams, the distance downstream that the sediment load will travel, or point in time and the duration when an increase in sediment delivery to aquatic features will occur. The reasons for this include the large variability in the magnitude of direct effects from a given land disturbance, inability to predict secondary or indirect effects, lack of data on recovery rates for land disturbances, difficulty of validating predictive models on-the-ground, and the uncertainty of future events such as the size and timing of large storms. As a result, an assessment of CWE is frequently reported as an indicator of the overall *risk* of cumulative effects occurring in a watershed (Reid 1993).

The magnitude or severity of CWE following land disturbance depends largely on an event that cannot be prevented and the exact timing of which cannot be accurately predicted. It is whether a “large storm event” occurs within several years after land disturbances when the ground surface is vulnerable to erosion. If a large storm event does not occur within several after the land disturbance, the CWE to aquatic features will be minor, negligible, or absent. As a result of the importance of large storm events in determining actual erosion, sediment delivery to streams, turbidity and suspended sediment levels of streams, the land disturbances themselves in the watersheds play only a partial role in the severity of impacts to aquatic resources.

The method is not a substitute for an on-the-ground evaluation of the condition of an aquatic feature. For example, a segment of a stream may be severely degraded on-the-ground in a watershed that is considered to be at a *moderate* risk of CWE. This can occur when severe disturbance, such a large number of skid trails and roads, are constructed next to one segment of a stream.

Results

A number of land disturbances have occurred or are expected to occur in the watersheds that contain the Freds Fire Reforestation Project.

A number of roads, both paved and unpaved, are present. Other miscellaneous impervious areas, such as buildings and parking lots, are also present.

The Freds Fire of October 2004 burned approximately 70 percent of the project area at a high and moderate severity.

Most of the areas burned at a high and moderate severity by the Freds Fire were salvage logging on both ENF and on private lands owned by Sierra Pacific Industries in 2005 and 2006.

Past timber harvest - prior to 2009 - has occurred on both private land and in the ENF.

The Silver Saddle Forest Health Project will occur in the Kyburz watershed on the south side of the South Fork American River. The Silver Saddle Forest Health Project will involve fuels reduction activities over a period of six years, starting in 2010.

The Freds Fire Reforestation Project would occur on approximately 3,320 acres of the ENF.

Sierra Pacific Industries will continue to use herbicides on private land to maintain timber stands that were planted in areas salvage logged in 2005. Approximately 1,000 acres of timber stands are being maintained with hexazinone and 1,526 acres with glyphosate.

The above land disturbances have resulted in the following conclusions concerning the risk of Cumulative Watershed Effects (CWE). The risk of CWE for each watershed is illustrated in Figure 3-20.

The Kyburz 7th field watershed will be at a *very high risk* of CWE in 2011 under Alternative 1 (Proposed Action). The risk of CWE is *high* under Alternatives 2 (No Action) and 3 (No use of herbicides).

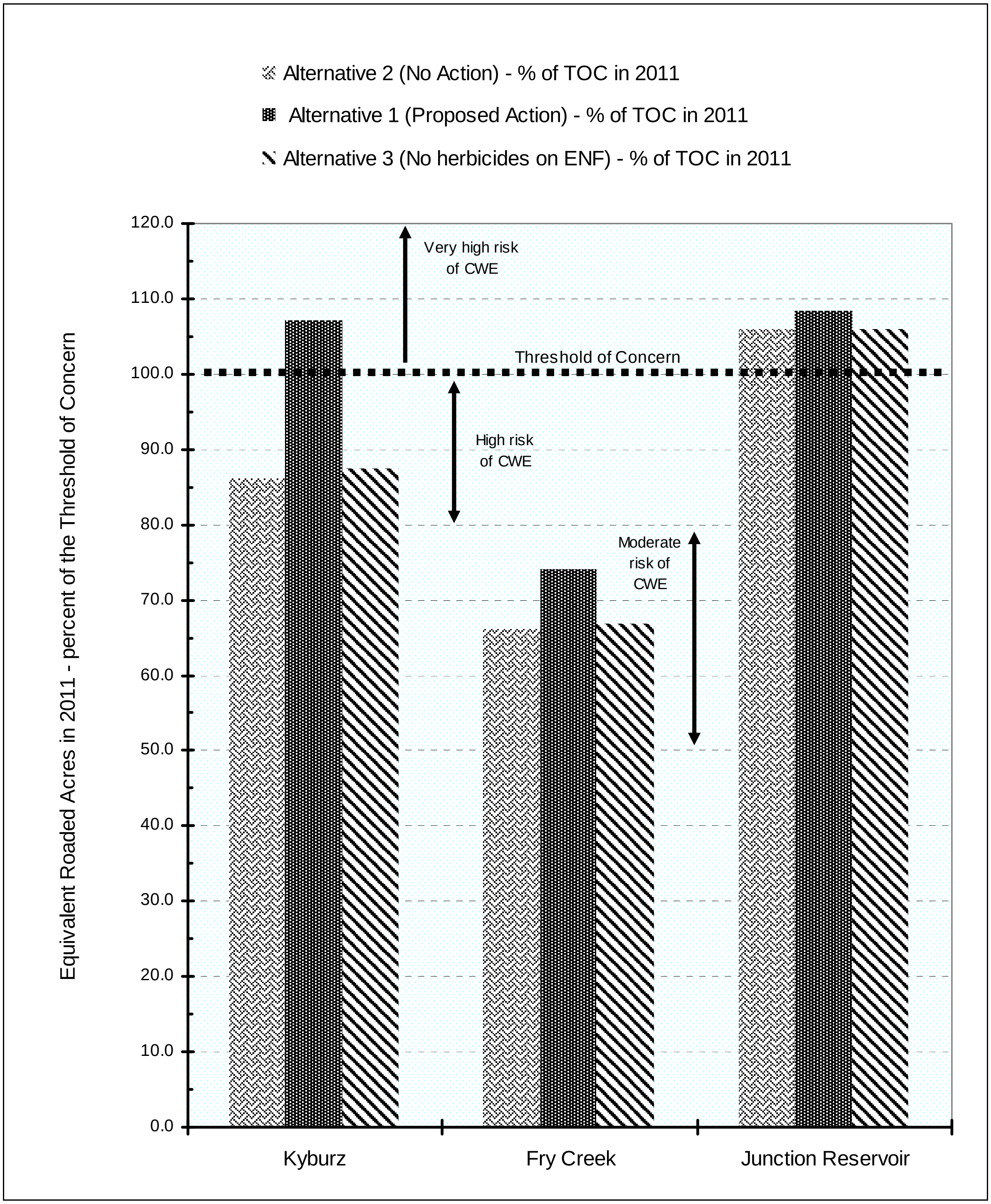
The Fry Creek 7th field watershed is at a *moderate risk* of CWE in 2011 under all alternatives.

The Junction Reservoir 7th field watershed is at a *very high risk* of CWE under all alternatives.

The risk of CWE is the same for 2010, 2011, and 2012 for all three watersheds. This is because the Equivalent Roaded Acres (ERA) for all three watersheds is similar for 2010 through 2012.

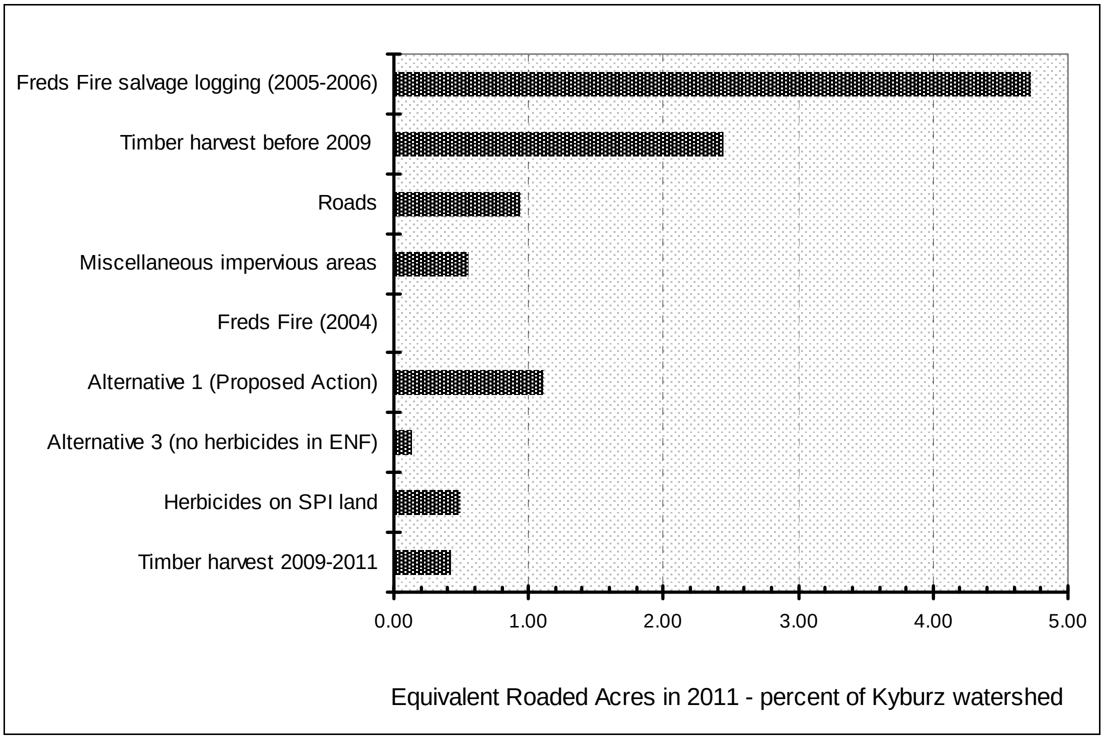
The risk of CWE for each watershed is largely the function of the salvage logging of the Freds Fire in 2005/2006, other past timber harvest, and roads. Alternative 1 (Proposed Action) is a small portion of the risk of CWE. This is illustrated in a comparison of the ERA generated from the individual land disturbances for each watershed (Figures 3-21 through 3-23).

Figure 3-20. Equivalent Roaded Acres (ERA) in 2011 – Expressed as Percent of the Threshold of Concern – for the Junction Reservoir, Fry Creek, and Kyburz Watersheds.



CWE = cumulative watershed effects. TOC = threshold of concern. The percent ERA displayed in this figure is similar in 2010 and 2012.

Figure 3-21. Land disturbances in the Kyburz watershed.



(ENF = Eldorado National Forest. SPI = Sierra Pacific Industries)

Figure 3-22. Land disturbances in the Fry Creek watershed.

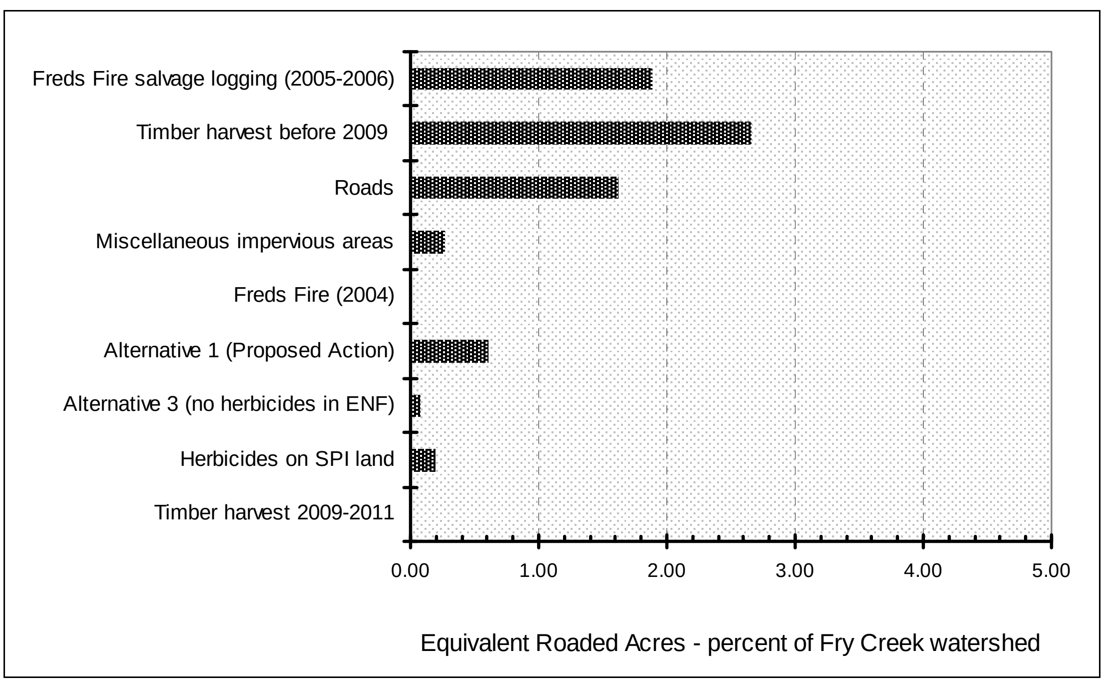
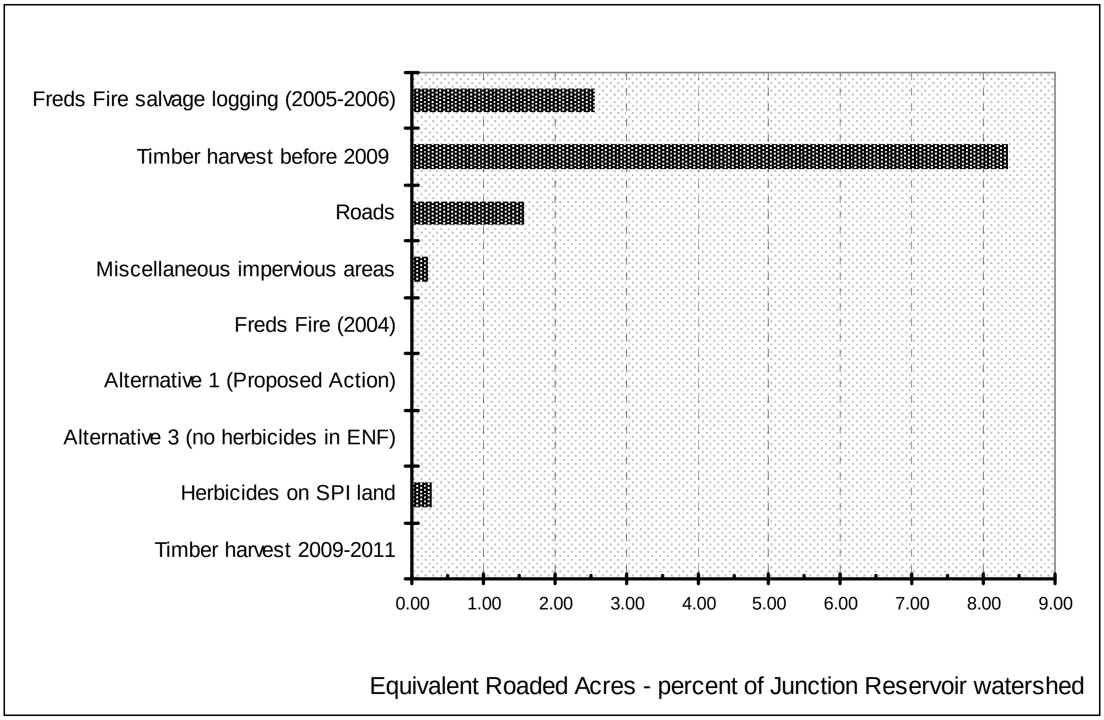


Figure 3-23. Land disturbances in the Junction Reservoir watershed.



Water quality - herbicides

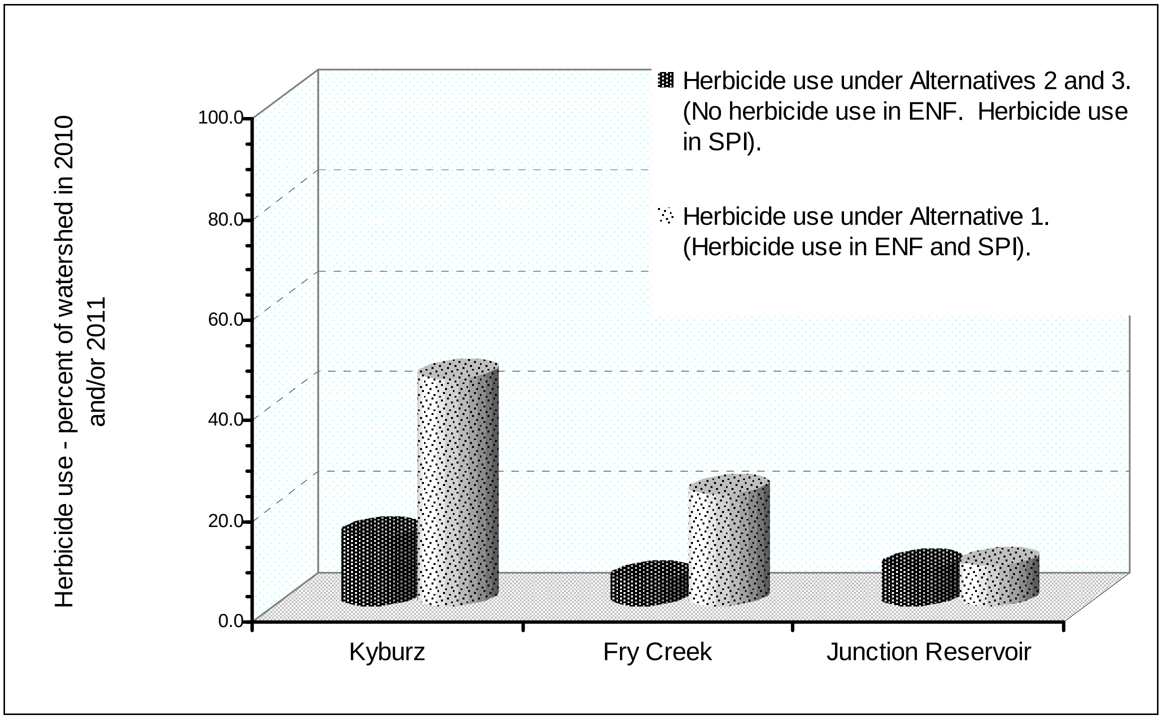
The analysis area for CWE (the 7th field watersheds of Kyburz, Fry Creek, and Junction Reservoir) contains private lands owned by Sierra Pacific Industries (SPI). Herbicides will be used on SPI land under all alternatives, and the SPI lands bordering the ENF.

Alternatives 2 (No Action) and 3 do not involve the use of herbicides in the ENF; therefore, cumulative impacts to water quality from the use of herbicides under those two alternatives will not occur. Cumulative impacts to water quality from herbicides are not expected under Alternative 1 (Proposed Action), despite the fact that the use of herbicides on lands owned by SPI increases the percent of the Kyburz and Fry Creek watersheds that will be sprayed with herbicides (Figure 3-24). There two reasons for this conclusion.

There will be “no spray” buffer widths of at least 50 feet next to live water on SPI land (Stapleton 2006). As a result, the risk of the contamination of surface water by herbicides on lands owned by SPI borders on negligible. The effectiveness of “no spray” buffer widths in protecting water quality has been previously described in detail in the section describing *Domestic Use of Water*.

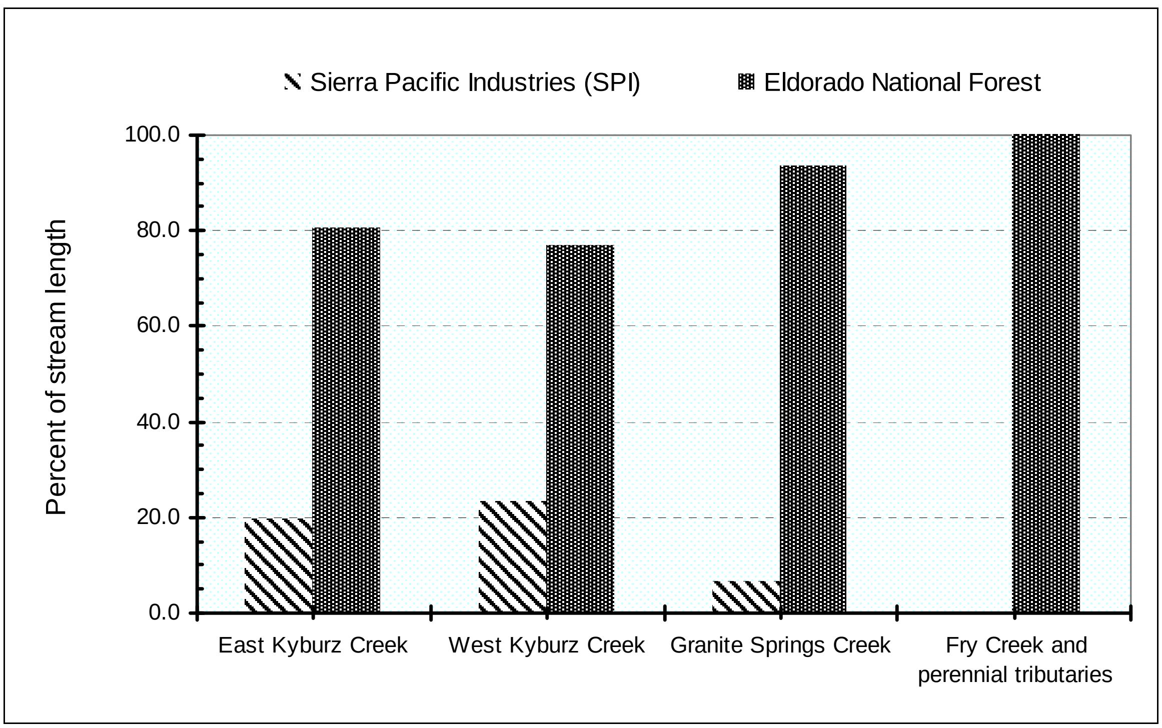
Lands owned by SPI border a small portion of the length of perennial streams in the project area. The ENF borders all of Fry Creek and much of Granite Springs Creek, East Kyburz Creek, and West Kyburz Creek (Figure 3-25).

Figure 3-24. Herbicide Use by Watershed for each Alternative in 2010 and/or 2011.



(ENF = Eldordo National Forest. SPI = private land owned by Sierra Pacific Industries).

Figure 3-25. Land Ownership Adjacent to Perennial Streams.



Aquatic Biology

Affected Environment

The elevation range of the Freds Fire area is approximately from 3,900 to 6,800 feet; the elevation range of the affected segment of the South Fork American River, immediately adjacent and south of the project area, is approximately 3,600 to 5,000 feet. Within the proposed project area, both perennial and seasonal streams can best be characterized as high gradient bolder and cobble controlled transport channels that have sand and gravel components. The predominant aquatic habitats are the perennial streams, including Fry Creek and two of its tributaries, two unnamed streams north of Twenty-nine Mile Guard Station that flow into one channel just north of Highway 50, East and West Kyburz Creeks, and two unnamed perennial streams north and east of Kyburz. Perennial stream within the project area all have gradients that exceed two percent. . Within the project area, south facing slopes are dominant; however, spur ridges generally tend to have a north-south orientation with east and west aspect. Similarly, most drainages tend to have a north-south orientation. Tables 3-25 and 3-26 provide a description of aquatic habitats.

Post-fire ecosystem recovery is directly linked to burn intensity, slope location (e.g. mid-slope vs. ridge top; convex vs. concave), anthropogenic disturbance (e.g., road building, salvage harvest), precipitation, and ground water discharge. In the vicinity of Fry Creek, the fire burned ridgetops and left riparian vegetation essentially unscathed. This vegetation is presently providing a high level of stream shading along many streams, affecting both water temperatures and primary production (Table 3-26).

The Freds Fire has also influenced ground water discharge rates. Throughout the fire area, springs have surfaced, sometimes creating, enhancing, and enlarging aquatic features. Vegetation in these aquatic features often includes willows, cattails, rushes, sedges, and horsetail (*Equisetum spp*.). Several landslide complexes exist within the project area that include large deep-seated landslides. Because of their size and depth (usually 30 feet and deeper), the role of vegetation in helping stabilize these features is minimal except along the margins of the slide mass where the landslide depth diminishes to 3 feet or less (Koler 2007). Water movement within these landslides varies; however, on August 25, 2006 a discharge rate of approximately 30 gallons per minute was measured on one landslide situated on an unnamed stream channel that was classified as an ephemeral stream prior to the fire (Figure 3-26).

The Granite Springs meadow/spring complex, a special aquatic feature that contains meadows and/or springs, covers 10.5 acres and was surveyed as part of Riparian Conservation Objective analysis. Small rills and some sheet erosion were noted upslope of the aquatic feature; however, lush riparian vegetation within the feature was providing soil stability. Three other meadow/spring complexes were mapped for inclusion in the overall analysis, including a 2.5 acre feature near Forest Road 11N42D and two meadow/spring complexes (3.6 acre and 0.25 acre) near the junction of Forest Roads 11N42 and 11N99. Anthropogenic disturbance in these meadows was greater than observed disturbance in the meadow selected for the Riparian Conservation Objective analysis; most notable was a diversion of streamflow in the perennial channel north of Forest Road 11N99 in the Granite Springs complex.

None of the streams in the project area are known to support fish. The fish species known to occur in the South Fork American River adjacent to and downstream of the project area are: Sacramento sucker (*Catostomus occidentalis*), riffle sculpin (*Cottus gulosus*), rainbow trout (*Oncorhynchus mykiss*), and brown trout (*Salmo trutta*). Hardhead (*Mylopharodon* conocephalus), a USDA Forest Service Sensitive Species, is not present in the project area but is known to occur 17 miles downstream of the project area in the South Fork American River below the Silver Creek confluence (FERC 2003).

Figure 3-26. Measuring water discharge on an active landslide north of the confluence of the South Fork American River and the Silver Fork American River.

Forest Service Manual (FSM) 2672.42 directs that a biological assessment be prepared for all proposed projects that may have effects upon United States Fish and Wildlife Service listed threatened, endangered, and proposed species. This document is to ensure that project decisions do not adversely affect Federally listed species or result in the loss of species viability. FSM 2670.32 directs that a biological evaluation be prepared to determine project effects upon Forest Service designated sensitive species. This document is to ensure that project decisions do not create significant trends towards Federal listing for sensitive species. The Biological Assessment/ Biological Evaluation (BA/BE) for Aquatic species can be found in the Project file.

Pursuant to Section 7(c) of the Endangered Species Act of 1973 as amended, the US Fish and Wildlife Service is contacted to obtain a current list of threatened, endangered, proposed, and candidate species that may be present on the Eldorado National Forest. The most recent quarterly species list for the Eldorado National Forest was dated January 29, 2009 and obtained from the US Fish and Wildlife Service website (http://sacramento.fws.gov/es/spp_lists/NFFormPage.htm on March 3, 2009. Table 3-29 lists the threatened, endangered, or sensitive aquatic species that that may be present in Eldorado National Forest, their preferred habitats, and whether, based on the activities the project proposes, the species has the potential of being adversely affected by any activities of the proposed project. Species that may be affected by activities proposed by this project are shaded.

Table 3-29. Threatened, Endangered, or Sensitive Aquatic Species that may be Present in Eldorado National Forest

Species	TES Status	Elevation Range of Habitat	Preferred Habitat	Potential for Alternative 1 to Affect this Species
California red-legged frog and proposed critical habitat	threatened	Below 5,000 feet	Ponds and slow-moving streams	Although within the elevational range, it has been determined that regulated flows and spring releases from impoundments negate the potential for reproduction on the only low-gradient reaches found below 5,000 feet on the South Fork American River immediately downstream of the proposed project. The proposed units are not within critical habitat.
Central Valley spring-run Chinook salmon	threatened	N/A	Central Valley delta and up rivers to man-made and natural barriers	None. Design Criteria and BMPs will prevent adverse effects downstream.
Central Valley steelhead	threatened	N/A	Central Valley delta and up rivers to man-made and natural barriers	None. Design Criteria and BMPs will prevent adverse effects downstream.
delta smelt	threatened	N/A	Sacramento-San Joaquin delta	None. Design Criteria and BMPs will prevent adverse effects downstream.
foothill yellow-legged frog	FS sensitive	Below 6,000 feet	Low gradient streams with cobbles, riffles, and open areas	Suitable habitat exists within and immediately adjacent to the project area. Implementation of the Proposed Action may affect individuals but is not likely to result in a trend toward federal listing.
hardhead	FS sensitive	30-4,800 feet	Sacramento-San Joaquin delta, S. Fork American River	Design Criteria and BMPs will prevent adverse affects where they reside approximately 17 miles downstream.
Lahontan cutthroat trout	threatened	N/A	High elevation and east slope streams and lakes	None. No known populations have the potential to be affected by the proposed project.
Sierra Nevada yellow-legged frog	FS sensitive	Above 5,000 feet	High elevation low-gradient streams and small ponds	Suitable habitat exists within the project area. Design Criteria and BMPs will prevent adverse effects.
northern leopard frog	FS sensitive	From sea level-7,000 feet	Perennial streams and ponds	None. Incidental historical occurrence for this species on Forest at Riverton and off-Forest in the Lake Tahoe Basin.
western pond turtle	FS sensitive	Below 5,000 feet	Ponds and slow moving streams	Suitable habitat exists within the project area. Implementation of the Proposed Action may affect individuals but is not likely to result in a trend toward federal listing.
winter-run chinook salmon	endangered	N/A	Central Valley delta and up rivers to man-made and natural barriers	None. Design Criteria and BMPs will prevent adverse effects downstream.
Yosemite toad	FS sensitive	Above 6,400 feet	High elevation wetland areas and meadows	None. No known populations have the potential to be affected by the proposed project. Outside of species' known range.

California Red-legged Frog -Threatened

There has been an occurrence of this species adjacent to the ENF approximately 12.2 miles west-southwest of the Freds Fire Reforestation area in the North Fork Weber Creek drainage. Here, on

Bureau of Land Management land, egg masses and adults have been detected in Spivey Pond between 1998 and 2005. In addition, one female was detected in a pond on Ralston Ridge on the powerline transmission corridor, on June 18, 2001; this location is approximately 22.5 miles northeast of the project area.

There are no California Red-legged Frog Critical Habitat Units within the proposed Freds Fire Reforestation area. However, since the US Fish and Wildlife Service (2003a) defined suitable habitat for the California red-legged frog as low-gradient streams (two percent or less in gradient) below 5,000 foot in elevation, a GIS analysis of the Freds Fire Reforestation area for streams meeting that criteria was performed. That analysis indicated that the only perennial stream that met these criteria was the South Fork American River, immediately outside the project area.

Surveys for California red-legged frog habitat were conducted in 2002 and 2003 during the Sacramento Municipal Utility District's (SMUD) hydropower re-licensing process downstream of the project area on the South Fork American River in suitable habitat (SMUD 2004). The SMUD visual encounter survey effort focused on post-metamorphic frogs; egg mass and/or tadpole surveys were not conducted. No California red-legged frogs were observed.

California red-legged frog surveys were also conducted by ECORP Consulting, Inc.; they were contracted by the El Dorado Irrigation District (EID) to survey for frogs in the Project 184 area that included the South Fork American River and several of its tributaries. ECORP (2002) determined that the South Fork American River tributaries between Pacific House and the gauging station east of Twenty-nine Mile Guard Station are high gradient streams that generally lacked suitable habitat for the California red-legged frog. They selected alternative sites considering springs, stock ponds, and one reservoir; however, of these sites, six were on private land and access was denied, and two others lacked suitable habitat (ECORP 2002). No California red-legged frogs were observed at the two target California red-legged frog survey locations. Consultation with the US Fish and Wildlife Service was formalized on this project with a Biological Opinion issued (USDI Fish and Wildlife Service 2003a); this opinion concurred with the ECORP finding that the aforementioned reach of the South Fork American River American River lacked suitable habitat.

Adult California red-legged frogs may move from breeding sites and at any time of year during periods of wet weather; some individuals may make upland excursions (USDI Fish and Wildlife Service 2004). California red-legged frogs are known to travel up to 2.25 miles from a non-breeding habitat to a breeding habitat. However, it is thought that this distance is the upward limit of dispersal and that a 1.25 mile dispersal element will ensure breeding habitat connectivity (USDI Fish and Wildlife Service 2003b, 2004). Thus, a GIS analysis of existing waterbodies relative to low-gradient stream reaches was performed. This analysis determined that there was one fen and one spring, Granite Springs, on NFS land within the project boundary. Both the fen and Granite Springs are above 5,000 foot in elevation and, therefore, would not provide suitable habitat for California red-legged frog reproduction. The South Fork American River immediately adjacent to the proposed project was the only perennial low-gradient stream that could potentially be affected by the proposed project. California red-legged frogs would not be observed in a large riverine environment such as the South Fork American River according to the US Fish and Wildlife Service (2003a).

The above analysis indicated that there were no streams within the proposed Freds Fire Reforestation area that contained the basic essential elements for long-term California red-legged frog occupancy, i.e., breeding and foraging habitat combined with dispersal habitat and associated upland habitat for forage, shelter, and water quality maintenance.

Sierra Nevada Yellow-legged Frog

The Sierra Nevada yellow-legged frog is listed as a sensitive species for the ENF. In the Sierra Nevada, the Sierra Nevada yellow-legged frog (*Rana muscosa*) is found from approximately 5,000 feet to over 12,000 feet in elevation; the historic range of this species frog extends from Plumas County to Tulare County (Jennings and Hayes 1994). This frog is seldom far from water and prefers well illuminated, sloping banks of meadow streams, riverbanks, isolated pools, and lake borders with vegetation that are continuous to the water's edge (Martin 1992, Zeiner and others 1988). Sierra Nevada yellow-legged frogs have also been observed using a variety of habitats, including grassy streambanks, large boulders adjacent to deep stream pools, fallen trees extending into lakes, and along rocky lake shorelines adjacent to deeper water (Elliott pers. comm. 2000). Shallows along stream and lake margins are used by tadpoles to absorb heat to enhance metabolic rate (Jennings and Hayes 1994).

Approximately 2.4 miles of perennial stream is located in the Freds Fire area above 5,000 feet in elevation; approximately 1.4 miles of perennial stream above 5,000 feet is located on NFS lands which could potentially be Sierra Nevada yellow-legged frog. Four ponds are located within the fire area; however, they are all located on private lands.

ECORP Consulting Inc, (2002) performed an analysis of surveys performed by the California Department of Fish and Game in proximity of the proposed Freds Fire Restoration; ECORP was contracted by the El Dorado Irrigation District to survey for amphibians, including Sierra Nevada yellow-legged frogs, in the Project 184 area that included the South Fork American River and several of its tributaries. Both the ECORP analysis and an analysis of the Eldorado National Forest Herpetofauna GIS layer indicated that there no reported observations of Sierra Nevada yellow-legged frogs in the project area; however, there is a known population of Sierra Nevada yellow-legged frogs approximately 1.5 miles south of the project area along Middle Creek. First observed in 1993, more than 625 individuals in various life stages have been observed along this stream between the confluence of Silver Fork American River and the Forest Road 11N18 crossing.

Foothill Yellow-legged Frog

The foothill yellow-legged frog is listed as a sensitive species for the ENF. The foothill yellow-legged frog was common in the Sierra Nevada historically; thus, almost every Sierran creek below 6,000 foot elevation has the potential to be inhabited by this species. Within the Freds Fire area, there are 3.69 miles of perennial stream, all of which have gradients that exceed 2 percent in gradient. Within the analysis area that includes the South Fork American River from the Freds Fire area to its confluence with Silver Creek, approximately 13 miles of the 21 miles of the South Fork American River has gradients that are ≤ 2 percent; these lower gradient reaches would provide potentially suitable habitat for the foothill yellow-legged frog. The nearest known sighting of foothill yellow-legged frogs to the Freds Fire Project area was in the South Fork American River in 2002 approximately 5.4 miles downstream of the proposed project area; there have been several additional foothill yellow-legged frog sightings downstream of this observation.

ECORP Consulting, Inc. (2002, 2004) performed surveys in and adjacent to the proposed project; they were contracted by the El Dorado Irrigation District to survey for amphibians, including yellow-legged frogs, in the Project 184 area that included the South Fork American River and several of its tributaries. Twelve ECORP survey sites corresponded to the drainages adjacent to the proposed project; at four of these sites foothill yellow-legged frogs were observed (ECORP 2002, 2004). Foothill yellow-legged frog surveys were also conducted along the South Fork

American River by Garcia and Associates in 2005. Both survey results by site location and life stage observed are displayed in Table 3-30.

Table 3-30. ECORP Foothill Yellow-legged Frog Surveys along the South Fork American River between the Confluence of the South Fork American River with Silver Creek and Sand Flat Campground (ECORP 2002, 2004, Garcia and Associates 2005).

Location	Sightings? (Y/N)	Life stages – numbers observed			
		Adults	Juveniles	Larvae	Eggmasses
South Fork American River upstream of Silver Creek					
ECORP	Y	4	6	-	-
GANDA	Y	4	2	63	2
South Fork American River at old Blackbird Campground	Y	1	1	-	-
South Fork American River at Grays Canyon Creek	Y	2	-	2	-
South Fork American River at Pacific House	N	-	-	-	-
South Fork American River at Ogilby Creek					
ECORP	Y	-	7	-	-
GANDA	N	-	-	-	-
South Fork American River upstream of Ogilby Creek					
GANDA	Y	2	-	-	1
South Fork American River at 29-mile Guard Station	N	-	-	-	-
South Fork American River at Indian Creek Campground	N	-	-	-	-
South Fork American River upstream of Bull Creek	N	-	-	-	-
South Fork American River downstream of Alder Creek	N	-	-	-	-
South Fork American River upstream of Fry Creek	N	-	-	-	-
South Fork American River downstream of Carpenter Creek	N	-	-	-	-
South Fork American River upstream of Carpenter Creek	N	-	-	-	-
Totals		**13**	**16**	**65**	**3**

Note: All survey protocols and survey results can be found in the Fisheries Department located in the Supervisor's Office of the Eldorado National Forest.

Within the Freds Fire Reforestation Project, Fry Creek and its tributaries were surveyed during the 2004 field season by ENF fisheries personnel. No observations of foothill yellow-legged frogs were reported.

Western Pond Turtle

Western pond turtles are habitat generalists, occurring in a wide variety of permanent and intermittent aquatic habitats; however, they prefer to have pools nearby to escape from predators and basking sites such as large logs and boulders. Most populations currently exist in smaller streams, usually in montane environs. Habitat needs can be varied; western pond turtles are not restricted to any certain type of habitat and could potentially be found in most streams below

5,000 feet in elevation. Within the analysis area that includes the South Fork American River from the Freds Fire area to its confluence with Silver Creek, approximately 13 miles of the 21 miles of the South Fork American River has gradients that are ≤ 2 percent; these lower gradient reaches would have a higher probability of providing suitable habitat for the western pond turtle than the higher gradient bedrock-controlled stream reaches within the fire area. A GIS analysis of south and southwest facing slopes with a slope angle of 15 degrees or less, adjacent to perennial streamcourses, indicates that approximately 76 acres of nesting and overwintering habitat for western pond turtles exists in the proposed project area. Although the Federal Energy Regulatory Commission (FERC 2003, p. 136) analysis of the South Fork American River determined that "[the] gradient on the SFAR [South Fork American River] and tributaries is higher than that of optimum pond turtle habitat," one adult western pond turtle was observed 1.3 miles south of the project area along the Silver Fork American River in July 1993. No western pond turtles were observed during the special-status amphibian surveys conducted by ECORP (2002) for the hydroelectric re-licensing of the El Dorado Hydroelectric Project, FERC No. 184-065.

Environmental Consequences

The geographic scope of the direct, indirect, and cumulative effects analysis is confined to the streams and water channels within the watersheds affected by Freds Fire and the South Fork American River downstream of its confluence with Silver Creek (approximately 21 miles).

Effects of all Alternatives on California Red-legged Frog

Direct and Indirect Effects

The species and habitat account for California Red-legged Frog indicated that there were no streams within the proposed Freds Fire Reforestation area that contained the basic essential elements for long-term California red-legged frog occupancy, i.e., breeding and foraging habitat combined with dispersal habitat and associated upland habitat for forage, shelter, and water quality maintenance. The South Fork American River, immediately adjacent to the proposed project, was the only perennial low-gradient stream that could potentially be affected by the proposed project. California red-legged frogs would not be observed in a large riverine environment such as the South Fork American River according to the US Fish and Wildlife Service (2003a). Therefore, there would be no direct or indirect effects.

Cumulative Effects

There are no streams within the proposed Freds Fire Reforestation area that contained the basic essential elements for long-term California red-legged frog occupancy; therefore, there would be no cumulative effects.

Determination of Effects

Alternatives 1, 2, and 3 will not affect the California red-legged frog or its habitat.

Effects of all Alternatives on Sierra Nevada Yellow-legged Frog

Direct, Indirect and Cumulative Effects

The existing stream habitat for Sierra Nevada yellow-legged frogs within the project area is higher gradient than where these frogs are typically found. They would not be expected to be seen in these streams as they have never been observed in any streams nearby. Also, the stream habitat downstream in the South Fork American River is unsuitable for them to be residing there because of high winter flows and a generally larger river than they are usually found. Because they would not be expected to be residing there, none of the alternatives would cause effects to them or their habitat.

Determination of Effects

Project design criteria and Best Management practices will prevent adverse effects. Therefore, Alternatives 1, 2, and 3 would have no effect on the Sierra Nevada yellow-legged frog.

Alternative 1 (Proposed Action)

Effects common to all species

Direct and Indirect Effects

Potential direct and indirect effects to the aquatic system resulting from the implementation of Alternative 1 generally tend to fall into three primary categories:

Herpetofauna mortality due to crushing during tree planting (e.g., scalping) and fuels reduction activities (e.g., mastication).

Hillslope erosion due to removal of vegetation by herbicides.

Effects to herpetofauna populations and their aquatic habitats due to exposure of herbicides, surfactants, and dyes.

Effects from Planting and Fuels Reduction Activities

Given the paucity of past herpetofauna observations, the recent fire, and that most channels within the proposed project area are high gradient boulder and cobble controlled transport channels, it is not likely that populations of herpetofauna are present within the proposed project area. The foothill yellow-legged frog is highly aquatic and generally found within 33 feet of water, while the western pond turtle is not. Thus, the potential for herpetofauna mortality due to planting activities would be minimal and generally confined to western pond turtle individuals. Similarly, because of stream buffers, mortality from mastication activities would be limited to western pond turtles.

Hillslope Erosion due to Removal of Vegetation by Herbicides

As described in the Hydrology and Watershed Resources Section (Chapter 3), in the short-term (less than 10 years), there will likely be only a slight increase in sediment delivery to streams during and immediately after storm events because ground disturbance from tree planting and herbicide use will be small, ground disturbance within RCAs will not be concentrated in a few large areas where surface runoff can accelerate and cause erosion, and stream buffers are adequate for conifer release (hand or herbicide) and mastication equipment treatments.

Effects to Herpetofauna Populations and Aquatic Habitats from Exposure to Herbicides, Surfactants, and Dyes

Given the Resource Protection Measures for the aquatic features (Chapter 2), the main project action that would be a concern for aquatic and aquatic-dependent species is the direct or indirect effects to these species and their habitats from herbicide application. Herbicide treatments have the potential to affect the aquatic environment and aquatic/aquatic-dependent species through contamination, misapplication (directly to the water surface), spray drift, precipitation-related overland flow, a spill, and/or leaching or percolation into groundwater.

Two factors determine the degree of adverse affects of herbicide application on aquatic and aquatic-dependent species: 1) the likelihood that an organism would be exposed to toxic levels of the herbicide, and 2) the toxicity of the herbicide to an organism.

Exposure

Direct exposure: Direct exposure of aquatic species could occur from an accidental spill, through contamination of water from misapplication (directly to the water surface), or through direct application, spray drift, precipitation-related overland flow, and/or leaching or percolation into groundwater.

An accidental spill would constitute the greatest potential for an acute event. An accidental spill incident involving chemical transport, mixing, and storage would be very unlikely as procedures and requirements are designed to prevent such an event (BMP 5-10: Pesticide Spill Contingency Planning.) and have been shown to be effective. The likelihood of exposure from a herbicide spill is low due to BMP 5-10, which includes measures to reduce the risk of contamination of water by accidental spills.

Contamination of surface water and ground water would be minimized due to the width of the no spray/no plant buffer strips along streams and special aquatic features (Table 2-4), and by the implementation of BMP 5-13 (Controlling Pesticide Drift During Spray Applications), which includes 1) using ground application equipment; 2) ceasing application when weather parameters exceed label requirements, precipitation, or forecast of greater than a 70 percent chance of precipitation in the next 24 hours (except hexazinone); 3) requiring a relatively large droplet; 4) requiring low nozzle pressures; 5) requiring the spray nozzle be kept within 24 inches of vegetation being sprayed; and 6) requiring a pressure gauge or pressure regulator on the backpack sprayers.

Thus, the possibility of herbicide mobilization in ephemeral stream channels is for the most part reduced, being largely dependent on the herbicide and the proximity of the herbicide to water. Mobilization of herbicides would be dependent on a number of factors including juxtaposition of the unit relative to seasonal and perennial channels, the amount of rain, the flow of the stream, the chemical used, and soil type.

There are no known populations of foothill yellow-legged frog or western pond turtle in the project area. However, potentially suitable habitat for these species exists within the analysis area, which includes the South Fork American River. A known sighting of foothill yellow-legged frog was is the South Fork American River, 5.4 miles downstream of the project area. Given the paucity of past herpetofauna observations, the recent fire, and that most channels within the proposed project area are high gradient boulder and cobble controlled transport channels, it is not likely that populations of herpetofauna are present within the project area. Thus, the potential for direct exposure is low.

Food Supply: As algae are a source of food to tadpoles, exposure of algae to herbicides could indirectly affect tadpoles. Algae could be exposed to herbicides through contamination, misapplication (directly to the water surface), spray drift, precipitation-related overland flow, a spill, and/or leaching or percolation into groundwater. No herbicide buffers around aquatic features will reduce the risk of exposure. Spot applications of glyphosate to invasive plants have no buffer next to streams. Applications in these areas, totaling an estimated seven acres, would result in a greater risk of exposure to algae.

Habitat: Adjacent to several perennial streams terrestrial riparian plants are providing shade, regulating microclimates, and reducing water temperatures that create and enhance habitat complexity. Exposure of theses riparian habitats to herbicides has the potential to affect these habitats. With the no herbicide buffers around aquatic features employed for most herbicide treatments (Table 2-4), the integrity of the existing riparian condition should be maintained in the short-term (<25 years).

Toxicity

The direct adverse effects to an organism is dependent upon the toxicity of the chemical and the dose received. Factors influencing adverse effect include, but are not limited to, the likelihood of receiving a dose and the magnitude of dose (in terms of amount and duration). Magnitude of dose is responsible for acute, chronic, and subchronic toxicities.

Acute toxicity is a measure of a chemical's effect based on a short exposure. Acute exposure is a contact with a chemical that occurs for only a short period of time. Acute exposure can occur at a lethal (inducing death) or sublethal level (inducing behavioral changes, i.e. decreased avoidance response). Acute toxicity is commonly reported as a time-concentration relationship, whereby a test organism is subjected to a given concentration of a substance over a period of time. A typical endpoint is the death of 50 percent of the test organisms (lethal concentration = LC_{50}).

An accidental spill would constitute the greatest potential for an acute event. An accidental spill incident involving chemical transport, mixing, and storage would be very unlikely as procedures and requirements are designed to prevent such an event, and have been shown to be effective. An accidental spill incident during application could also occur. Best Management Practices provide guidance for emergency spill procedures and are designed to minimize the magnitude of effect resulting from a spill

In chronic and subchronic toxicity, the organism is subjected to continuous or repeated exposures at lower concentrations over a longer period of time. The response of the organism to the chemical may be slight or delayed, with effect manifested over a range of temporal scales, including the life span of the individual to multiple generations. These exposures are most likely if chemical was present in ground water and subsequently entered surface flow, or if rain events created overland flow and mobilized residual herbicide from leaf surfaces or soil. Chronic and subchronic exposure can adversely affect individual growth or the function of certain organs and can have systemic effects with neurological, immunological, endocrine function, reproductive, teratogenic (birth defect), carcinogenic, and mutagenic implications

Potential roles of toxicants (Carey and Bryant 1995) include: a) affecting the susceptibility of herpetofauna young to disease; b) retarding growth and development of herpetofauna young; c) affecting the ability of larvae to avoid predation; d) affecting the development of physiological, morphological, or behavioral processes in a manner that subsequently impairs the ability of the young for future reproduction; and e) directly causing mortality of young. Additionally, recent research on Ranid frogs indicates that standard toxicology testing for certain pesticides may underestimate the power of pesticides when combined with other stressors such as predators (Renner 2004). However, these issues are not well understood, and more studies are needed before the roles of environmental xenobiotics in amphibian declines are fully understood.

A summary of the general chemical characteristics of the herbicides proposed for use indicates that, with the exception of triclopyr ester (BEE), these herbicides have a low toxicity rating for most aquatic species. In terms of these ratings, it should be noted that toxicity ratings are based on studies where one species often times serves as a benchmark for certain groups of similar organisms. However, in the case of some vertebrates, toxicity to a specific species could vary by life stage. In addition, different vertebrate species within the same genus can be affected differently by the same chemical concentrations and toxicity within a group of organisms (e.g. aquatic macroinvertebrates, algae and macrophytic biomass) generally varies by species. Thus, although the general toxicity rating for a specific herbicide may range from low toxicity to practically non-toxic, it doesn't necessarily mean that all aquatic species in that group (e.g., freshwater aquatic macrophytes, amphibians, etc.) will react in the same manner to the herbicide. Consequently, for species other than those studied, the toxicity ratings noted below should be viewed as general guidelines

Estimated exposure doses for aquatic species are based on the planned herbicide application rates for this project and are located in the project file. They follow the same methodology as the Site-Specific Human Health Risk Assessment (Appendix D). They are based on USDA (2003) and the SERA Risk Assessments.

To quantitatively characterize risk to aquatic species a hazard quotient was calculated. The quantitative risk characterization is expressed as the hazard quotient, which is the ratio of the estimated exposure doses to the NOEC, LC_{50}, EC_{50}, or some other an index of acceptable exposure. Tables 3-31 through 3-35 provide a summary of risk characterization for aquatic species. Worksheets are in the Project File.

Clopyralid

Application of clopyralid would be limited to scattered occurrences of yellow starthistle. Clopyralid is not as readily degraded as glyphosate. Clopyralid degradation is driven by microbial processes only; environmental factors that affect microbial activity, such as soil moisture and temperature, also affect the degradation of clopyralid. Clopyralid persisted in 95% of the soils less than 69 days, with a range of 8 to 250 days (19 soils tested) (DowElanco 1997). Clopyralid does not bind tightly to soil and thus would seem to have a high potential for leaching (SERA 2004b). While there is little doubt that clopyralid will leach under conditions that favor leaching—sandy soil, a sparse microbial population, and high rainfall, the potential for leaching or runoff is functionally reduced by the relatively rapid degradation of clopyralid in soil. A number of field lysimeter studies and a long-term field study indicate that leaching and subsequent contamination of ground water are likely to be minimal (SERA 2004b).

There is no data regarding the toxicity of clopyralid to amphibian species (SERA 2004b), therefore fish data will be used as a surrogate. Clopyralid has low toxicity to fish and invertebrates. For acute exposures of 96 hours, an acute LC_{50} value of 103.5 mg/L is used to characterize risk for trout (SERA 2004b). Prolonged 21-day LC_{50} for rainbow trout is 321 mg/L (DowElanco 1997). A standard chronic reproduction study on *Daphnia magna* reports an NOEC of 23.1 mg a.e./l (SERA 2004b), which is the value used in SERA to characterize longer term risk. Clopyralid appears to have a very low potential to cause any adverse effects in any aquatic species, although confidence in this risk characterization is reduced by the lack of chronic toxicity studies in fish (SERA 2004b). As some fish species may be more sensitive to clopyralid than daphnids, a lower chronic NOEC of 10 mg a.e./l is used to characterize long-term risk in sensitive fish (SERA 2004b).

Chronic exposure to low concentrations of herbicides over longer periods of time can cause "sublethal stress" which can lower the immune system of organisms and cause them to be more susceptible to changes in their environment (Cary 1993).

Technical grade clopyralid contains hexachlorobenzene and pentachlorobenzene as contaminants. Nominal or average concentrations of hexachlorobenzene and pentachlorobenzene are less than 2.5 ppm and 0.3 ppm, respectively. Hexachlorobenzene is ubiquitous and persistent in the environment. Virtually all individuals are exposed to hexachlorobenzene and virtually all individuals have detectable concentrations of hexachlorobenzene in their bodies (SERA 2004b).

Hexachlorobenzene is classified as a potential carcinogen by the U.S. EPA, and has shown carcinogenic activity in three mammalian species. Hexachlorobenzene may be readily absorbed across the skin and will bioconcentrate in fish (ATSDR 1998, SERA 2004b) and is very persistent in the environment. Although the amount of hexachlorobenzene in technical grade clopyralid is relatively low, the potential for a proportion of the exposure dose that might be absorbed, is higher than that for clopyralid itself (SERA 2004b). Because of the persistence of hexachlorobenzene, the possibility exists that it would remain in the soil and could be transferred to surface waters by rainfall in the autumn where it would be bound to sediments or bioconcentrated in aquatic organisms (ATSDR 1998).

The Site-Specific Risk Assessment worksheets for clopyralid for an application rate of 0.25 lbs/acre, shows modeling results with hazard quotients for fish as being 0.009 for a worst case scenario with an accidental spill. Any number under 1 is considered as being not a significant hazard. The highest hazard quotient at the Peak Estimated Environmental Concentration for sensitive fish is 0.0002. Amphibians were not included in the SERA risk assessment worksheets for clopyralid, and the risk assessment worksheet for hexachlorobenzene did not incorporate either fish or amphibians. In summary, the toxicity of clopyralid is very low, and the quantity of hexachlorobenzene in clopyralid is small. With buffers protecting areas with water, effects on frogs would not be expected.

In general, there is risk for clopyralid to adversely affect algae, which is food for tadpoles. Table 3-31 shows the hazard quotients for accidental spill and Estimated Environmental Concentration for algae, which is food for tadpoles. Both hazard quotients are below 1 and considered as not being a significant hazard.

Table 3-31. Summary of Hazard Quotients for Aquatic Species – Clopyralid

Summary of Concentration in Water						
		Concentrations (mg/L)				
	Scenario	Central	Lower	Upper		
	Accidental Spill	0.9084	0.9084	0.9084		
	Peak EEC	0.005	0.00125	0.0175		
	Longer-term EEC	0.00175	0.00025	0.00325		
Summary of Risk Characterizations at Highest Application Rate (0.25 lbs/acre)						
Receptor	Scenario	Hazard Quotients			Toxicity Values (mg/L)	Toxicity Endpoint
		Central	Lower	Upper		
Fish						
Sensitive Species						
	Accidental Spill	9E-03	9E-03	9E-03	103	LC_{50}
	Peak EEC	5E-05	1E-05	2E-04	103	LC_{50}

the direct spray and contaminated vegetation scenarios, a small mammal is used as a surrogate species.

For longer term exposures to glyphosate, the most relevant study remains the life cycle toxicity studies done in fathead minnow. In this study, the NOEC was 25.7 mg/L. No effect on mortality or reproduction was observed at this concentration.

Sub-lethal studies on carp were conducted over 14-days of exposure to concentrations of 2.5, 5, 10 mg a.e./L. At 10 mg/L abnormal histopathologic changes were noted in the gills and liver. At 5 mg/L, abnormal histopathologic changes were noted only in the gills. These changes were accompanied by increased alkaline phosphatase activity. While these effects cannot be directly associated with potential longer term effects on fish populations, the histologic changes in the gills and liver would be classified as adverse. While it is conceivable, based on this study, that the some at least transient histopathologic effects could occur at the NOEC was 25.7 mg/L, in terms of the risk assessment, the life cycle NOEC of 25.7 mg/L remains the most appropriate basis for risk characterization (SERA 2003a).

The dose-response assessment for fish is substantially complicated by information indicating that some fish species such as salmonids (which includes native trout) are more sensitive to glyphosate than other species of fish and by information indicating that some surfactants are very toxic to fish and may substantially increase to the toxicity of glyphosate to fish. The SERA risk assessment (SERA 2003a) estimated a chronic NOEC of 2.57 mg/L for technical grade glyphosate in sensitive species of fish based on an observed NOEC value of 25.7 mg/L in tolerant species of fish. This is based on a relative potency method where acute effects to sensitive fish occurred at a dose that was 10 times lower than acute effects to more tolerant fish.

There is no scientific basis that glyphosate causes specific toxic effects on the nervous system, immune system, or endocrine function (SERA, 2002).

The Site-Specific Risk Assessment worksheets for glyphosate for an application rate of 4.8 lbs/acre (Table 3-32), shows modeling results with hazard quotients for fish as being 1.4 for a worst case scenario accidental spill. Any number over 1 is considered as being a significant hazard. An accidental spill could expose an aquatic organism to a possibly harmful dose of pesticides. The Site Specific Human Health Risk Assessment (Appendix D) described a spill scenario in a pond that resulted in a concentration of glyphosate of 14.4 mg/l. For juvenile frogs (*Crinia insignifera)* the 48-hour LC_{50} was 83.6 mg/l for glyphosate (Bidwell and Gorrie 1995). In a spill scenario, besides the chance of a spill occurring being very low, the dilution factor in a stream would result in low risk of direct effects to frogs.

The highest hazard quotient at the Peak Estimated Environmental Concentration for sensitive fish is 0.2. There are no risk quotients for algae, which is food for tadpoles. Based on the studies described in SERA (section 4.1.3.4 and Appendix 11) they conclude that (Page 4-41) “glyphosate appears to be about equally toxic to both algae and macrophytes.” The Hazard Quotient for aquatic macrophytes is: 5 for spill, 0-0.6 for peak EEC, 0.0002-0.01 for longer term EEC.

Table 3-32. Summary of Hazard Quotients for Aquatic Species – Glyphosate

Summary of Concentration in Water						
		Concentrations (mg/L)				
	Scenario	Central	Lower	Upper		
	Accidental Spill	14.383	14.383	14.383		
	Peak EEC	0.096	0	1.92		
	Longer-term EEC	0.0048	0.00048	0.0384		
Summary of Risk Characterizations at Highest Application Rate (4.8 lbs/acre)						
Receptor	Scenario	Hazard Quotients			Toxicity Values (mg/L)	Toxicity Endpoint
		Central	Lower	Upper		
Fish						
Sensitive Species						
	Accidental Spill	**1.4**	**1.4**	**1.4**	10	LC_{50}
	Peak EEC	1E-02	0	0.2	10	LC_{50}
	Longer-term EEC	2E-03	2E-04	1E-02	2.57	NOEC
Aquatic invertebrate						
	Accidental Spill	2E-02	2E-02	2E-02	780	LC_{50}
	Peak EEC	1E-04	0	2E-03	780	LC_{50}
	Longer-term EEC	1E-04	1E-05	8E-04	50	NOEC
Macrophyte, aquatic						
	Accidental Spill	**5**	**5**	**5**	3	NOEC
	Peak EEC	3E-02	0	0.6	3	NOEC
	Longer-term EEC	2E-03	2E-04	1E-02	3	NOEC
Small Mammal						
	Direct Spray - 100 percent Absorption	0.7	0.7	0.7	175	NOAEL
	Direct Spray - First Order Absorption	7E-03	2E-03	2E-02	175	NOAEL

Hexazinone

Hexazinone would be applied on units 609-036, 038, 039, and 040. One ephemeral stream is located within 100 feet of units 609-036, 038, 39; unit 609-040 has a short segment of another ephemeral stream running through it and has another ephemeral stream immediately adjacent to its eastern boundary. As noted in Table 2-4, hexazinone would not be applied within 100 feet of these channels.

Since hexazinone is relatively mobile and can persist in ground water for years, there is a fairly high potential for off-site movement (Frazier and Grant 2003). Surface water monitoring results from the ENF for 1991 and 1992 indicated there was surface water contamination from spring snowmelt runoff with hexazinone concentrations ranging from 1.1-15.0 ppb (USDA 2001a). These monitoring efforts also indicated hexazinone could be detected more than five years after application at levels up to 1.0 ppb. Hexazinone is considered practically non-toxic to fish and amphibians. However, it is slightly toxic to some crustaceans, and toxic to certain algae and photoplankton at low concentrations. Thus, there is potential for chronic effects from hexazinone.

Based on the water monitoring data from the ENF studies, potential for surface water contamination and the expected concentrations of hexazinone, any direct or indirect affects would likely include effects to algae and amphibian larvae such as tadpoles who feed on algae. The risk characterization for amphibians is severely limited by the lack of data on the toxicity of hexazinone to amphibians. A concentration of 100 mg/L has been reported to cause transient reduced avoidance in newly hatched tadpoles (Berrill et al. 1994 in SERA 2005). This is essentially the only relevant information that is available on the toxicity of hexazinone to amphibians.

Based on 96-hour NOEC values, there is relatively little difference in sensitivity among fish species. The lowest and highest acute NOEC values come from the study by Sleight (1973 in SERA 2005): 160 mg/L for fathead minnows and 370 mg/L for trout. A single egg-and-fry study in fathead minnows (Pierson 1990a in SERA 2005) defines a NOEC of 17 mg/L. A much greater range of sensitivities is apparent in aquatic invertebrates than in fish. Based on standard acute (48 hour) bioassays, the most sensitive species is *Daphnia magna* with an NOEC of 20.5 mg/L .

The Site-Specific Risk Assessment worksheets for hexazinone at an application rate of 3 lbs/acre (Table 3-33), shows hazard quotients for fish as being 0.2 for a worst case scenario with an accidental spill. The highest hazard quotient for fish under the highest dose without stream buffers at the 3 lbs/acre application rate is 0.008. There is no data on amphibians in the risk assessment worksheets, therefore fish shall be used as a proxy. For algae at an application rate of 3 lbs/acre, shows hazard quotients of 9,072 for a worst case scenario with an accidental spill. The highest hazard quotient for algae under the highest dose without stream buffers at the 3 lbs/acre application rate is 300. The hazard quotient for the longer-term environmental effect concentration for algae is 53. Thus, if hexazinone reaches the streams in sufficient quantities, there are likely to be effects to algae growth, which is food for tadpoles. The NOEC for sensitive algae is 4 ppb. About 85 percent of 574 samples water monitoring samples for hexazinone in USFS Region 5 were below 4 ppb (USDA 2001a). Very wide stream buffers (Table 2-4) and the location of hexazinone application, over 1,000 feet from the nearest intermittent or perennial stream, reduces the risk that hexazinone would be present in streams at a level that would adversely effect algae.

Table 3-33. Summary of Hazard Quotients for Aquatic Species – Hexazinone

Summary of Concentration in Water						
		Concentrations (mg/L)				
	Scenario	Central	Lower	Upper		
	Accidental Spill	18.144	7.2576	36.288		
	Peak EEC	0.015	0.009	0.3		
	Longer-term EEC	0.06	0.00003	0.21		
Summary of Risk Characterizations at Highest Application Rate (3.0 lbs/acre)						
Receptor	Scenario	Hazard Quotients			Toxicity Values (mg/L)	Toxicity Endpoint
		Central	Lower	Upper		
Fish						
Sensitive Species						
	Accidental Spill	0.1	5E-02	0.2	160	NOEC
	Peak EEC	9E-05	6E-05	2E-03	160	NOEC
	Longer-term EEC	4E-03	2E-06	1E-02	17	NOEC
Aquatic invertebrate						
Sensitive Species						
	Accidental Spill	0.9	0.4	**1.8**	20.5	NOEC
	Peak EEC	7E-04	4E-04	1E-02	20.5	NOEC
	Longer-term EEC	6E-03	3E-06	2E-02	10	NOEC
Macrophyte, aquatic						
	Accidental Spill	**1,512**	**605**	**3,024**	0.012	NOEC
	Peak EEC	**1.3**	0.8	**25**	0.012	NOEC
	Longer-term EEC	**5**	3E-03	**18**	0.012	NOEC
Algae						
Sensitive Species						
	Accidental Spill	**4,536**	**1,814**	**9,072**	0.004	NOEC
	Peak EEC	**4**	**2**	**75**	0.004	NOEC
	Longer-term EEC	**15**	8E-03	**53**	0.004	NOEC

Triclopyr

Triclopyr BEE would be used in stands 609-010 and 609-034. One formulation of triclopyr BEE (Garlon 4) has been observed to cause behavioral (neurological) changes that may affect survivability in frog tadpoles when exposed to ¼ to ½ of lethal levels. This acute toxic level (LC_{50}) for tadpoles is greater than 1.2 ppm. (Berrill et al. 1994). Triclopyr BEE, which is more toxic to aquatic organisms than triclopyr acid, degrades in less than 1 day into the acid form of triclopyr. The half-life of triclopyr (acid form) is less than 2 days, and usually cannot be detected after 7 days. There is no scientific basis for asserting that triclopyr causes specific toxic effects on the nervous system, immune system, or endocrine function (SERA, 2002).

In a review of forest water quality monitoring region-wide from 1991 to 1999 (USDA 2001a), a few positive detections occurred from normal applications. All were at low levels (highest 2.4

ppb) and below any aquatic levels of concern according to SERA (2003c) and US EPA (1998). The width of stream buffers used when 2.4 ppb was detected was only ten to fifteen feet. The detection that resulted in the highest level of triclopyr (82 ppb) was the result of an absence of buffers on an ephemeral stream.

The Site-Specific Risk Assessment worksheets for an application rate of 2.4 lbs/acre (Table 3-34) shows hazard quotients for fish as being 29 for a worst case scenario with an accidental spill. The highest hazard quotient for fish under the highest dose without stream buffers at the 2.4 lbs/acre application rate is 4. There is no data on amphibians in the risk assessment worksheets, therefore fish shall be used as a proxy.

To reduce the risk that triclopyr would reach streams at levels that would result in effects to aquatic organisms, stream buffer were used in the project design. Region 5 monitoring results show that employing untreated buffers on streams reduces the rate of water contamination to near zero. One ephemeral stream runs through unit 609-10; the nearest perennial stream is over 3,000 feet south of the stand. One seasonal stream is located approximately 100 feet west of stand 609-034. This stream transitions to a perennial steam approximately 2,000 feet south of the stand. Using these buffers for triclopyr, the expected contamination is expected to be at or below that found in past water monitoring. Such a level of water contamination with triclopyr would represent a low risk of adverse effects to fish and amphibians.

TCP is a major metabolite of triclopyr and is found in both soil and water. TCP is substantially more toxic in fish than either triclopyr acid or triclopyr TEA, with acute LC_{50} values in the range of about 2 to 10 ppm, similar to the toxicity of triclopyr BEE. One longer term study, an early life-stage study in rainbow trout had a NOAEL of 0.0808 mg/L. The most sensitive endpoint involved growth – i.e., length and weight. For assessing the acute hazards of exposure to TCP, the lowest acute LC_{50} value (1.8 ppm from a Coho salmon study) is used. For longer term exposures, the early life-stage study in rainbow trout is used, with a NOEC of 0.0808 mg/L.

The risk characterization for TCP is considered quantitatively only for fish because toxicity data are available only for fish (SERA 2003b 2003c). For applications of triclopyr alone at a rate of 1 lb/acre, the highest peak concentration modeled using GLEAMS is about 0.011 ppm (on a small stream at rainfall rates of 150 to 200 inches per year) and the highest longer term average concentration is about 0.0005 ppm (on a small stream at rainfall rates of 100 to 250 inches per year). The worst case hazard quotients are about 0.006 for both short-term and long-term exposures. At the highest application rate proposed on this project (2.4 lbs/acre) hazard quotients for TCP would be 2.4 times higher (HQ = 0.015), below the level of concern by a factor of 65 (1/0.015 = 66.67). The use of chlorpyrifos in the same area would not increase exposure to TCP to concentrations that are anticipated to be toxic (SERA 2003b).

Table 3-34. Summary of Hazard Quotients for Aquatic Species – Triclopyr

Summary of Concentration in Water-Triclopyr						
		Concentrations (mg/L)				
	Scenario	Central	Lower	Upper		
	Accidental Spill	7.2672	7.2672	7.2672		
	Peak EEC	0.0072	0	0.96		
	Longer-term EEC	0.072	0.0192	0.12		
Summary of Risk Characterizations at Highest Application Rate (2.4 lbs/acre)						
Receptor	Scenario	Hazard Quotients			Toxicity Values (mg/L)	Toxicity Endpoint
		Central	Lower	Upper		
Fish						
	Accidental Spill	**29**	**29**	**29**	0.25	LC_{50}
	Peak EEC	0.03	0	**4**	0.25	LC_{50}
	Longer-term EEC	7E-04	2E-04	1E-03	104	NOEC
Aquatic invertebrate						
	Accidental Spill	0.8	0.8	0.8	8.55	LC_{50}
	Peak EEC	8E-04	0	0.1	8.55	LC_{50}
	Longer-term EEC	9E-04	2E-04	1E-03	80.7	NOEC
Macrophyte, aquatic						
	Accidental Spill	**104**	**104**	**104**	0.07	NOEC
	Peak EEC	0.1	0	**14**	0.07	NOEC
	Longer-term EEC	**1.0**	0.3	**1.7**	0.07	NOEC
Algae						
	Accidental Spill	**104**	**104**	**104**	0.07	NOEC
	Peak EEC	0.1	0	**14**	0.07	NOEC
	Longer-term EEC	**1.0**	0.3	**1.7**	0.07	NOEC

Chlorsulfuron

The Site-Specific Risk Assessment worksheets for an application rate of 3 ounces/acre shows only algae and aquatic macrophytes with hazard quotients exceeding 1. This occurs in the event of a spill and at peak EEC. These hazard quotients assume no buffer. However, the small acreage and the infestations' location, at least 1,500 feet from the nearest perennial and 600 feet from the nearest seasonal stream, reduces the risk that chlorsulfuron would reach a stream at levels to produce adverse effects to algae.

Surfactants and Dyes

Surfactants proposed for use in the Freds Fire Reforestation Project include nonylphenol polyethoxylate based (NPE) surfactants, methylated seed oil (MSO) based surfactants, and a silicone/modified vegetable oil blend.

NPE-based Surfactants (USDA 2003a)

The primary active ingredient in the NPE surfactant proposed for use is a component known as nonylphenol polyethoxylate (NPE). NP9E, the most common NPE used in surfactants for pesticide is a mixture that has, as a majority, 8-10 ethoxylate groups attached (NP9E is a standard shorthand for a NPE with an average of 9 ethoxylate groups (USDA 2003a)). An average of 8-10 ethoxylate groups makes these surfactants highly water-soluble. NPE surfactants may contain small amounts of un-reacted nonylphenol from the production process. Nonylphenol (NP) is a material recognized as hazardous by the U.S. EPA (currently on U.S. EPA's inerts list 2). Both NP and NPE exhibit estrogen-like properties, although they are much weaker than the natural estrogen estradiol.

In the forested environment, very little NP would be expected to arise in the environment as a result of the application of NPE, and what little NP might arise would be largely bound to soil or sediments and remain immobile while being biodegraded through microbial action. The more likely compounds to be formed in a forested environment would be the short chain carboxylates. Based on this pattern of breakdown, the compounds of concern are the short-chain carboxylates (NP1EC, NP2EC), rather than NPE, NP or the short-chain ethoxylates. NP1EC and NP2EC would remain in an aqueous state until they too are ultimately broken down.

Although NP is of higher toxicity to aquatic organisms than NPE or NPEC, there is sufficient information in the literature to make the assumption that in a forested environment, contamination of surface water is more likely to involve NPE in the short-term and short-chain carboxylates (NP1EC, NP2EC) in the longer-term. As such, indicators of risk will be based upon these two compounds, not NP.

Toxicity to Aquatic Organisms

Lapurga (1996, in SERA 1997c) describes studies of the aquatic toxicity of R-11®. The acute 96-hour LC_{50} (nominal concentration, static exposure conditions) in juvenile Bluegill sunfish (*Lepomis macrochirus*) was 4.2 mg/L, and in juvenile Rainbow trout (*Oncorhynchus mykiss*), 3.8 mg/L. The acute 48-hour LC_{50} in *Daphnia magna* was 19 mg/L.

Trumbo (2002, in SERA 2003a) reported the application of Rodeo® (1.5%) and the surfactant R-11® (0.5%) to three sites for the control of purple loosestrife. Water samples were collected from water near the application. At one site, glyphosate was monitored at 0.85 mg/L and the surfactant was monitored at 0.4 mg NPE/L and 0.0125 mg/L. When fathead minnows were exposed to this water in the laboratory, 30% mortality was noted after 96 hours and this mortality was significantly ($p<0.05$) greater than control mortality. As discussed by Trumbo (2002, in SERA 2003a), it is unlikely that the mortality was associated directly with glyphosate but the 96-hour LC_{50} for R-11 is about 4 mg/L or one-tenth of the monitored concentration of NPE and it is likely that the mortality was attributable to the surfactant.

A 96-hour toxicity test with the Rodeo®/R-11® mixture using Rana pipiens produced LC_{50} values of 6.5 mg/L for glyphosate and 1.7 mg/L for NPE, indicating that the mixture is moderately toxic to amphibians (Trumbo 2005). A comparison of toxic units for the herbicide and surfactant in the mixture indicated that the toxicity to larval frogs was likely due to R-11® and not Rodeo®.

A review of USDA 2003 showed that various NPEs have been acutely tested in on fish, aquatic invertebrates, and aquatic plants. To assess risk, the following values were used in USDA, 2003, and this risk assessment:

Dose-Response Assessment for Acute Exposures – NPE

Fish - 1,000 ppb, based on the aquatic acute no-effect level, is the 7-day NOEC (growth) for minnows (Dorn et al, 1993; Staples et al 1998, in USDA, 2003). This value will be used, with the assumption that acute toxicity tests involving NP9E includes a small percentage of the short-chain ethoxylates, as well as small amounts of NP.

Aquatic invertebrates – 10 mg/L, based on the 7-day NOEC of NP9E for *Daphnia* spp. (Dorn et al, 1993, in USDA, 2003) will be used for acute exposures

Aquatic plants – 8 mg/L based on the 96-hour NOEC (growth) of NP9E for green algae (Dorn et al 1993; Naylor 1995, in USDA, 2003.

Dose-Response Assessment for Chronic Exposures – NP1EC, NP2EC

Fish - 100 ppb, based on the NOEC of 1,000 ppb in fathead minnows. This value is divided an interspecies factor of 10.

Aquatic invertebrates – 0.024 mg/L, based on a 21-day NP NOEC for *Daphnia magna.* NP was used because no testing has been done using NP1EC-NP2EC.

Aquatic plants – The acute value of 8 mg/L will be used because there are no chronic exposure studies for aquatic plants.

Based on the limited data it appears that frogs are similar or somewhat less sensitive than fish species. Levels of exposure that result in low levels of risk to fish should, therefore, also be similarly protective of frogs.

Risk Characterization – For normal operations, none of the exposure scenarios approach a level of concern to aquatic organisms (Table 3-35). The highest hazard quotient (0.58) results from the chronic exposure to aquatic invertebrates at the upper level of exposure. These upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially.

A risk assessment for the NPE surfactant or overspray onto still water and a spill into a pond was analyzed in USDA (2003a). The overspray scenario could result in instantaneous highest concentration of 1.5 ppm NP9E (range 0.15 to 4.9 ppm), while the spill scenario would result in levels of NP9E of 6.1 ppm. This surfactant shall be used when there is a stream buffer included.

Both the overspray and the spill scenarios involve levels of NP9E that could represent a risk of toxic effects. The overspray scenario exceeds the acute NP9E threshold for fish by a factor of 1.5 (typical rate), up to a factor of 4.9 (highest rate). The overspray scenario should not represent an acute risk to aquatic invertebrates. With a spill, the NP9E threshold for acute effects to fish is exceeded by a factor of 6.1 (central estimate), up to a factor of 15.1 (highest rate), while for aquatic invertebrates, the threshold for acute effects is exceeded at the highest concentration rate, by a factor of 1.5. Aquatic plants would have values intermediate between fish and invertebrates. In a stagnant small pond or stream reach, there could be effects seen to aquatic organisms. In a live stream, the more realistic scenario would be a short-term pulse of concentrated NP9E moving downstream, mixing with water and being broken down into NP1EC-NP2EC and/or partitioning into sediments. The effects of a short pulse should be minor on aquatic organisms as the short exposure time would result in lower doses than are discussed here.

The spill exposure scenario is an arbitrary scenario. Scenarios that are more or less severe, all of which may be equally probable or improbable, easily could be constructed. All of the specific assumptions used to develop this scenario have a simple linear relationship to the resulting hazard quotient. Thus, if the accidental spill were to involve 20 rather than 200 gallons of a field solution of NPE, all of the hazard quotients would be a factor of 10 less. This scenario involving water contamination assumes that a small pond is affected, rather than a creek or river as would be more likely in this forested setting. The contaminated stream scenario presents a more realistic scenario for potential operational contamination of a stream. Even here, the use of stream buffers would reduce the likelihood of this scenario being realized during normal operations.

Table 3-35. Summary of Hazard Quotients for Aquatic Species – NPE-based Surfactants

Summary of Concentration in Water						
		Concentrations (mg/L)				
Scenario		Central	Lower	Upper		
	Acute	0.0125	0.0031	0.0312		
	Chronic	0.007	0	0.014		
Summary of Risk Characterizations at Highest Application Rate (2.0 lbs/acre)						
Receptor	Scenario	Hazard Quotients			Toxicity Values (mg/L)	Toxicity Endpoint
		Central	Lower	Upper		
Fish						
	Acute	0.013	3E-03	0.03	1	NOEC
	Chronic	0.07	0	0.14	0.1	NOEC
Aquatic invertebrate						
	Acute	1E-03	3E-04	3E-03	10	NOEC
	Chronic	0.29	0	0.58	0.024	NOEC
Plants, aquatic						
	Acute	1E-03	4E-04	4E-03	8	EC_{50}
	Chronic	9E-04	0	2E-03	8	EC_{50}
Small Mammal						
	Direct Spray - 100 percent Absorption	**4.8**	**4.8**	**4.8**	10	NOAEL
	Direct Spray – First Order Absorption	8E-03	1E-03	0.1	10	NOAEL

Methylated seed oil (MSO) surfactants (USDA, 2007a)

Methylated seed oil surfactants are proposed with aquatic formulations of glyphosate. Methylated seed oil is formed from common seed oils, such as canola, soybean, or cotton. The U.S. Food and Drug Administration (FDA) considers methyl and ethyl esters of fatty acids produced from edible fats and oils to be food grade additives. There is little toxicity testing done on these surfactants. Standard acute toxicity testing on aquatic species is limited. The LC_{50} for aquatic species with one methylated seed oil (Hasten®) is 74 mg/l for 96 hours with rainbow trout and the EC_{50} is >50 mg/l for 48 hours with *Daphnia magna*.

Silicone/MSO blend surfactants (USDA, 2007a)

Silicone/modified vegetable oil blends (such as Syl-Tac®) includes silicone-based surfactants (USDA 2007a) and vegetable oils. Silicone/MSO blend surfactants would be used with herbicides when there are stream buffers included. There is little information in the scientific literature on effects of seed oils and silicone-based surfactants on aquatic organisms (USDA, 2007a). There is some information on a brand name, Syl-Tac®. In USDA (2007a), the 96 hour LC_{50} for rainbow trout and the 48 hour EC_{50} for Daphnia magna is >5 mg/l. No studies on amphibians with Syl-Tac® were found.

There is no indication that silicone/modified vegetable oil blend is carcinogenic or mutagenic and there is very little information regarding the environmental fate of silicone/modified vegetable oil blend. Thus, no reasonable inference on the potential risk to aquatic species resulting from the chronic exposure to silicone/modified vegetable oil blend can be made (USDA 2007a). However, as none or very little herbicide is expected to reach streams due to stream buffers, and in comparison to some herbicides, the effects from exposure are expected to be small.

Colorfast Purple (SERA 1997b)

The colorant dye Colorfast Purple does not require pesticide registration. As described in Chapter 3 (Human Health and Safety of Herbicide Use) a mouse study by Littlefield et al (in SERA 1997b) is the basis for a qualitative cancer risk assessment. In rats, there is an indication that the dye accelerates the development of leukemia; however, the effect is less remarkable than that observed in mice. Turkeys exposed to Basic Violet 3 in drinking water contracted occlusive laryngotracheitis (Clark et al. 1993, in SERA 1997b). A marker solution containing the dye, dihydroxyacetone, and acetone was associated with contact dermatitis, although the dye itself did not cause an allergic reaction (Cox et al. 1989, in SERA 1997b). In patch tests, concentrations between 0.01% and 5% of Crystal Violet lactone [CAS 1552-42-7] used in carbonless copy paper were associated with the development of contact dermatitis (Shehade et al. 1987, in SERA 1997b).

There is very limited information available on the environmental fate of Colorfast Purple. No reasonable inference on the other potential risks to aquatic species resulting from the chronic exposure to Colorfast Purple can be made. Colorfast Purple would be used with herbicides with stream buffers. Exposure to herpetofauna of herbicides, surfactants, and dyes are not expected by this project as stream buffer widths shall be applied, and the stream flow is expected to dilute the water, even if slight amounts of herbicides, surfactants, and dyes did enter streams.

Hi-Light Blue

The ingredients in Hi-Light Blue are considered proprietary. None of the ingredients are hazardous, and the dye contains no toxic chemicals (SERA 1997b). There is extremely little information available to use to select dyes to use as markers on vegetation. Although dyes are used extensively in many industrial and agricultural applications, their use is virtually unregulated and there is almost no guidance regarding the selection of dyes based on their efficacy or potential hazard.

The assessment of these risks is severely limited by the proprietary nature of dye formulations. For most of the available dyes, neither the colorants nor adjuvants in the dye formulation are disclosed by the manufacturers. Unless the compound is classified as hazardous by the U.S. EPA, the manufacturer is not required to disclose its identity. The U.S. EPA is increasing the testing requirements on new inerts; however, many of the inerts currently in use were not tested rigorously and their toxicity is not well characterized (SERA 1997b). Thus, when a colorant or other adjuvant in a dye formulation is not listed as hazardous and therefore not identified on the product label or MSDS it should not be concluded that the dye or adjuvant is not toxic (SERA 1997b).

Hi-Light® Blue dye is not required to be registered as a pesticide; therefore it has no signal word associated with it. It is mildly irritating to the skin and eyes. It would likely be considered a

Category III or IV material and have a Caution signal word if it carried one. Hi-Light® Blue is a water-soluble dye that contains no listed hazardous substances (USDA 2007a). It is considered to be virtually non-toxic to humans. Its effect on non-target terrestrial and aquatic species is unknown, however its use has not resulted in any known problems (USDA 2007a).

Synergism: A synergistic effect is a situation is which the combined effects of two chemicals is much greater than the sum of the effect of each agent given alone, such as a herbicide and a surfactant. Surfactants, by their very nature, are intended to increase the effect of a pesticide by increasing the amount of pesticide that is in contact with the target (by reducing surface tension). This is not synergism, but more accurately is a reflection of increased dose of the herbicide active ingredient into the plant. Although there is not much data in the technical literature, the references included in USDA, 2007a indicate a lack of synergistic effects between surfactants and pesticides.

Foothill Yellow-legged Frog

Direct and Indirect Effects

It is possible that foothill yellow-legged frogs could reside in the tributary streams of the South Fork American within this project as this area is within their known elevation range, although this is unlikely, as the nearest foothill yellow-legged frog sighting occurred 5.4 miles downstream.

The analysis of herbicide treatments, above, concludes that little herbicide is expected to enter tributary streams and the South Fork American River using the proposed stream buffers. The aquatic glyphosate treatments for yellow starthistle without stream buffers is expected to have very small amounts of herbicide, surfactant, and dye potentially enter the streams. Thus, it is possible, although unlikely, foothill yellow-legged frogs could be affected by herbicide exposure. If foothill yellow-legged frogs were exposed, the hazard quotients for normal operations are well below a threshold of concern for frogs. Amphibians breathe through their skin, these aquatic animals are very susceptible to water quality.

Indirect effects could occur to algae, which is food for tadpoles, by a herbicide spill that washed downstream (HQ=5) or from invasive plants treatments using glyphosate on an estimated seven acres on unbuffered streams. Foothill yellow-legged frogs reproduce in the South Fork American River 5.4 miles downstream, and an unlikely spill could affect algae, food for tadpoles. Invasive plant treatments may have a localized effect on aquatic plant and macroinvertebrate assemblages. The higher discharge of the South Fork American River would dilute herbicide concentrations, reducing the likelihood of effects to macroinvertebrates.

Western Pond Turtle

Direct and Indirect Effects

Individual western pond turtles (usually males) may have large home ranges and may wander within a given watercourse for several kilometers on a regular basis (Reese and Welsh 1997). Western pond turtle nests have been found as far as 435 yards from a stream (Reese and Welsh 1997) in open sunny areas on hillslopes, generally with a south to southwest facing aspect. It should be noted, however, that various studies have recorded considerable variances in distances western pond turtles travel overland away from the stream channel. According to Holland (1994, p.28), “The majority of nest sites discovered to date have been found on dry, well-drained soils with significant clay/silt content and low (<15 degree) slope. Most have been in open areas dominated by grasses or herbaceous annuals, with few shrubs or trees in the immediate vicinity.” Thus, plantations or skid roads could provide an ideal location for a western pond turtle to lay its eggs, especially those located on south facing slopes. However, individuals have been found on northwest to north facing slopes that are >15 degrees during either nesting or overwintering overland movements (Holst 2001).

Approximately 76 acres in the project area are nesting and overwintering habitat; therefore, individuals may be subject to anthropogenic disturbance when western pond turtles travel overland from outside the project area to lay their eggs between May and July; nests could be uncovered and eggs crushed (Table 3-36). Threats to nests and hatchlings would occur from May through March during the incubation period for western pond turtles.

Table 3-36. Seasonal Movements of Western Pond Turtles and Potential Disturbance

Month	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**
Disturbance to:												
Nesting individuals												
Eggs												
Overwintering individuals												

Shading indicates months when seasonal movement are likely.

Western pond turtle also move into upland slopes while overwintering. Overwintering movements are poorly understood. In the Sierra Nevada, the most likely time for western pond turtle overwintering movements is during the fall/late fall and early spring and would represent movements to and from upland overwintering sites.

Based western pond turtle seasonal movements (Table 3-36), there is a risk for disturbance to western pond turtles or their nests essentially year-round. As both planting and mastication are proposed within 76 acres of western pond turtle suitable habitat there is potential for these activities to affect individuals through physically disturbance (crushing).

Based on the natural history of the western pond turtle (Table 3-36), there is a risk for exposure of pesticides to western pond turtles or their nests at practically any time of year that spraying may occur. Western pond turtles moving on land, as well as their nests, could be exposed to glyphosate through direct spray, or from contact with contaminated vegetation. Data on herbicide toxicity for western pond turtles is lacking. For the direct spray and contaminated vegetation scenarios, a small mammal is used as a surrogate species. For glyphosate, these scenarios yield a hazard quotient less than 1, below the level of concern (Table 3-32). The highest hazard quotient (HQ= 0.7) assumes that 100% of the spray is absorbed through the skin. Hazard quotients based on first order dermal absorption yields a hazard quotient substantially below the level of concern (HQ = 0.007). For NPE-based surfactants, the direct spray scenario with 100% absorption yields a hazard quotient of 4.8 (Table 3-35). It is unlikely that 100% of herbicide spray would be absorbed through the skin as western pond turtle skin is not as permeable as amphibians, and they have a hard shell over a majority of their bodies. The hazard quotient for direct spray based on first order dermal absorption yields a hazard quotient substantially below the level of concern (HQ = 0.008). The likelihood of a turtle being sprayed is very small, as no western pond turtles have been observed in the project area, and it is likely that an applicator would see a western pond turtle before being sprayed. Somewhat more likely, a western pond turtle could travel through an area that was recently sprayed and make contact with the herbicide on its tough skin. The absorbed dose resulting from contact with contaminated vegetation is assumed to be 1/10 that associated with comparable direct spray scenarios (SERA 2003a). Thus, hazard quotients associated with contact with contaminated vegetation would be less than direct spray scenario.

Under normal operations in a stream setting, as described under the risk characterization for NPE-based surfactants, none of the exposure scenarios approach a level of concern to aquatic organisms. Western pond turtles are less likely to be affected by herbicide in a stream because of the dilution factor, their tough skin limits the absorption of herbicide into the body, and because they also spend time outside of water.

Changes in aquatic vegetation could affect individuals, as western pond turtles are omnivorous, eating both plants, insects, worms, fish, and carrion. Large scale effects to aquatic vegetation, such as from a spill, could effect the food of western pond turtles, which would affect them indirectly.

Cumulative Effects

The cumulative effects analysis common to all species includes Riparian Conservation Areas in the Freds Fire Restoration Project area and the South Fork American River downstream to its confluence with Silver Creek (approximately 21 miles). The area of cumulative effects analysis was bounded in this manner because the greatest potential for aquatic community degradation downstream and outside of the proposed project area would be associated with sediment delivery to stream channels. Silver Creek is the first major downstream drainage that has the potential to alter sediment delivery regimes in the South Fork American River due to the volume of water it contributes to the South Fork.

The proposed project includes treatment acres shown on Table 2-1 on NFS land within the Fry Creek, Junction Reservoir, and Kyburz watersheds. Past, present, and reasonably foreseeable site preparation and conifer release projects on privately owned lands within the affected watersheds will affect an additional 2,526 acres of land.

In assessing cumulative effects, impacts of past actions were included for actions implemented since 1992. Actions preceding that date were included only if they had the potential to influence species population dynamics, species habitat (e.g. in-channel large woody debris, and/or sediment delivery to streams), or general watershed condition. Similarly, impacts of reasonably foreseeable future actions were included within the next 10 to 15 years were considered based on their probability of influencing species populations and/or aquatic community components, particularly riparian vegetation, vegetation in and adjacent to special aquatic features, and sediment delivery to streams. The temporal scope was selected because, as demonstrated by Gresswell (1999), depending on the characteristic being considered, alterations in aquatic community components due to wildfire are generally the greatest for five to ten years although large woody debris levels may remain higher than normal for 15 years or more. The Aquatic Species BA/BE contains past, present, and reasonably foreseeable future actions and the effects of those actions (project file).

In the discussion below, it is acknowledged that region-wide (e.g., population isolation and decline with consequent extirpation could occur due to the decreased size of potential source populations, the increased distance from source populations, and direct predation on dispersing individuals [Hanski 1989, Sjogren 1991]) and worldwide influences (e.g., effects of acid precipitation, ultraviolet radiation, viruses, pesticides, habitat destruction, predation, global climate change, and synergistic interactions among these factors) may have or are continuing to have an adverse affect on aquatic and aquatic-dependent herpetofauna populations. Understanding the extent to which these factors may have affected local herpetofauna populations in the Freds Fire Reforestation Project area is beyond the scope of this analysis, so too is an analysis determining the extent to which these factors will continue to effect local herpetofauna populations.

Past Land Disturbances: Timber harvest has occurred throughout the Peavine Ridge/Highway 50 corridor vicinity since the late 1800s (Coulter pers. comm.). During the past decade protective measures for streamside zones in timber harvest areas have become more restrictive. And, although timber harvest plans on private land during the past decade have had stream buffer requirements that protect the streams, the intensity and size of these activities on private land vary; in many cases, such harvest has resulted in fragmentation of habitat for many species. Additionally, harvest activities had the potential to decrease and degrade the amount of aquatic suitable habitat (Dunham et al 2003).

In the Freds Fire area, past timber harvest and associated road/skid trail building is evident. In many instances such harvest and road building have adversely influenced aquatic habitats by increasing sediment delivery to streams and reducing large woody debris levels and recruitment. It is unknown to what extent these anthropogenic activities affected specific aquatic and/or aquatic-dependent populations or habitat. Additionally, many of the effects from past anthropogenic disturbance may have been minimized by the Freds Fire.

Watersheds within and immediately adjacent the project area have also been affected by the 1981 Wright's Fire, the 1992 Cleveland Fire, and the 2002 St. Pauli Fire. Salvage timber harvest and reforestation took place on NFS and private lands subsequent to both the Wrights and Cleveland fires. The extent to which each of these events and the ensuing timber harvest affected specific aquatic and/or aquatic-dependent populations or habitat was described in the NEPA analyses for these project areas.

Observations made during the Riparian Conservation Objective analysis for this project indicate that downcutting has occurred along 60 percent of the surveyed reaches (Table 3-26). Sediment delivery from sources within the Riparian Conservation Area were observed on all the perennial reaches surveyed for the analysis, as well as on the majority of seasonally flowing tributaries to these streams. Sheet erosion, rill erosion, and headcuts were observed on 60 percent of the surveyed channels and gulling was observed on 40 percent of the channels. Quite frequently, erosion and sediment delivery to stream channels was associated with old skid trails from salvage harvest activities and Maintenance Level 1 and 2 NFS roads.

Anthropogenic disturbance has occurred in and along the Granite Springs Road near the Granite Springs Meadow Complex. In the past, such disturbances included off-highway vehicle use and dispersed camping. Prior to the Freds Fire on NFS land above Forest Road 11N99, streamflow in the perennial channel northeast of Granite Springs was diverted. Presently, the most prominent disturbances in the Granite Springs area are associated with salvage harvest, both on privately owned and NFS lands. This is particularly evident along the same perennial channel described above (Figure 3-27).

Figure 3-27. Stream channel alteration due to salvage harvest on privately owned lands in the vicinity of Granite Springs. ***May 24, 2006***

Subsequent to the salvage timber harvest on NFS lands within the Freds Fire Reforestation Project area approximately 1,870 acres were planted.

Salvage harvest also occurred on private lands within the Freds Fire. Acres harvested by logging system on private lands are unknown. Similarly, the extent of transportation system improvements and new road construction on privately owned lands is unknown. However, timber harvest on private lands is regulated by the California Department of Forestry and Fire Protection under the provisions of the California Forest Practice Act and additional rules enacted by the State Board of Forestry and Fire Protection. Streamcourse protections measures afforded under state forest practice rules are generally less restrictive than those governing timber harvest on NFS lands. Under State rules, harvest may occur within 50 feet of streams that maintain aquatic habitat for non-fish aquatic species (CDF 2005), whereas under the SNFPA (USDA 2004b), no harvest zones may be as much as three to four times greater, thus reducing the potential for sediment delivery to streams from harvest activities.

Present Land Disturbances: Present land disturbance projects would not necessarily have a localized affect on the stream channels in the project area. However, any anthropogenic land disturbance affecting the stream corridor upstream from the project could potentially contribute to cumulative effects that could adversely affect aquatic and aquatic-dependent species populations on NFS lands, e.g., increased sediment delivery and turbidity.

Across the landscape, the effects to the aquatic habitats within the project area due to dispersed recreation are low, although localized hillslope erosion with a consequent sediment delivery to aquatic features has been observed. Recreation use within the project area is limited and confined to specific locations. Dispersed camping and off-highway vehicle use generally occur in specific areas along the Granite Springs Road. During hunting season, there is an increase in dispersed camping and off-highway vehicle use, although such use is still generally characterized as low. Other recreation use within and adjacent to the project area includes rock climbing which is confined to Sugarloaf and Phantom Spires; the use at Sugarloaf is low whereas, the climbing use at Phantom Spires would be characterized as moderate (Valdes pers. comm.).

Foreseeable Future Land Disturbances: Foreseeable future land disturbances that have the potential to affect herpetofauna include anthropogenic disturbances such as dispersed recreation, introduction of exotic species, and land management activities.

Sierra Pacific Industries applied glyphosate and hexazinone for conifer release on their lands within the Freds Fire area; they will not be applying any herbicides within 50 feet of live water.

As noted in the Hydrologic Analysis, the increase in the amount of sediment delivered to streams will likely be slight and the recovery of streams in the project area that are currently degraded (primarily as a result of the Freds Fire of 2004 and salvage logging in 2005) should continue.

Overall, dispersed camping and off-highway vehicle use could generally be characterized as low (Schroeder pers. comm.). However, because vegetation is lacking and skid trails are still visible from system roads, there is the potential that off-highway vehicle use may exacerbate existing erosion problems within the project area.

In terms of introductions of exotic species, bullfrogs (*Rana catesbeiana*) are an introduced species that have been implicated in declining populations of a number of native Californian frog species; adult bullfrogs prey on native frog species and reach population densities that potentially have adverse affects on other amphibian populations (Alford and Richards 1999, Jennings 1996). Bullfrogs have been observed in the South Fork American River approximately 7.5 miles downstream of Fry Creek. No bullfrogs are known to be present within the project area.

Conclusions

As noted above, Sierra Pacific Industries applied glyphosate and hexazinone for conifer release on their lands within the Freds Fire area. However, they will not be applying any herbicides within 50 feet of live water. Thus, there is little likelihood that chemical conifer release treatments on Sierra Pacific Industries lands will contribute to cumulative effects within the Freds Fire Reforestation Project area.

Based on the above discussions, the likely cumulative effects of primary concern on NFS lands from an aquatic ecosystem perspective are:

- Maintenance or restoration of (1) the geomorphic and biological characteristics of special aquatic features; (2) streams; and, (3) hydrologic connectivity both within and between watersheds to provide for the habitat needs of aquatic-dependent species.
- Enhancement or maintenance of physical and biological characteristics associated with aquatic- and riparian-dependent species and their habitats.
- Restoration and enhancement of special aquatic features to provide the ecological conditions and processes needed to recover or enhance viability of species that rely on these areas.

Sierra Nevada Ecosystem Project found that aquatic, riparian, and meadow ecosystems are the most degraded of all habitats in the Sierra Nevada, although much of this problem was related to lower elevation dams and diversions (USDA 2004b). Historical data on changes in meadow ecosystems and special aquatic features are incomplete; however, available information suggests that both the number and size of these types of features has declined due to several reasons, including fire exclusion and conifer encroachment.

In terms of physical and biological characteristics associated with aquatic- and riparian-dependent species and their habitats – currently within several of the Riparian Conservation Areas adjacent to perennial streams, terrestrial riparian plants are providing shade, regulating microclimates, and reducing water temperatures that create and enhance habitat complexity. Riparian plant species are also providing organic materials that serve as food for aquatic organisms such as macroinvertebrates (Welsh et al 1998). Recent research has demonstrated that inputs of terrestrial detritus plays a critical role in the food web of forested headwater streams because "…headwater food webs are largely supported by inputs of allochthonous detritus…" (England and Rosemond 2004). Data from research on seven headwater streams in Georgia "…suggest that riparian deforestation, even over a narrow range, can result in decreased terrestrial support of headwater stream food webs (England and Rosemond 2004). Similarly, Kiffney et al (2003) demonstrated that that periphyton and aquatic insects in headwater streams were highly sensitive to forest harvest. Their results showed "…that abiotic and biotic attributes were even higher in the 30-m (98-ft) buffer treatment compared with controls during some seasons (Kiffney et al 2003)." This is consistent with the conclusion reached by Welsh et al (1998) that condition and functionality of Class II and III streams can determine downstream habitats. Thus, it is apparent that past fires, subsequent timber harvest, and reforestation activities adjacent to streams in the project area had and still have the potential to affect aquatic habitats and the presence/absence of aquatic and aquatic-dependent species both within and adjacent to the project, but also downstream of the proposed project.

Foothill Yellow-legged Frog

Cumulative Effects Unique to this Species

As there is little likelihood that chemical conifer release treatments on Sierra Pacific Industries lands will contribute to cumulative effects within the Freds Fire Reforestation Project area, there are no anticipated cumulative effects.

Determination of Effects

Alternative 1 may impact individuals, but is not likely to cause a trend toward Federal listing or a loss of viability for the foothill yellow-legged frog.

Western Pond Turtle

Cumulative Effects Unique to this Species

One of the major causes in the decline of western pond turtle populations, based on historic accounts, was extensive commercial harvest of the species as a food source. From approximately the 1870s to the 1930s, western pond turtles were harvested commercially; millions were sold in San Francisco markets (Ashton et al 1997). And, although there has been a ban on the sale and/or exhibition of native reptiles and amphibians since the 1980s, illegal collection of turtles has occurred (Ashton et al 1997). The extent to which these activities have affected western pond turtle populations in the analysis area is unknown.

Western pond turtle nests have been found as far as 435 yards from streams, far exceeding traditionally protected buffer zones afforded under the provisions of the California Forest Practice Act (and additional rules enacted by the State Board of Forestry and Fire Protection) or the Riparian Conservation Area widths established by the SNFPA. Thus, because western pond turtles travel into upland environs frequently and oftentimes for prolonged periods of time, they are more susceptible ground disturbing activities.

Crushing of individual western pond turtles by vehicles is also suspected of contributing significantly to mortality (Ashton et al 1997, Gibbs and Shriver 2002). As suggested in recent studies, as road densities increase, the potential for individual western pond turtle mortality due to crushing by vehicles also increases, particularly in those areas where roads such as Highway 50 parallel streams (Ashton et al 1997).

Given the amount and juxtaposition of nesting and overwintering habitat for western pond turtles within the project area, it is unlikely that the cumulative effects resulting from the Proposed Action will affect western pond turtle populations.

Determination of Effects

Alternative 1 may impact individuals, but is not likely to cause a trend toward Federal listing or a loss of viability for western pond turtle.

Alternative 2 (No Action)

Direct and Indirect Effects

Implementation of Alternative 2 would result in natural recovery. There would be no direct or indirect effects to aquatic and/or aquatic-dependent species. The risk of a large wildfire in the project area might be greater under Alternatives 2 than under Alternative 1 (Proposed Action). The potential effects of a large wildfire include a short-term (generally less than five years) degradation of water quality and aquatic habitat in the project area - this in turn can impair downstream beneficial uses of water. The severity and extent of such impacts from large wildfires is highly variable and depends on many factors; some large wildfires result in negligible impacts to water quality, aquatic habitat, and beneficial uses of water.

Cumulative Effects

Presently within the Freds Fire Reforestation Project area, aquatic features are recovering from two recent disturbances, the Freds Fire of October 2004 and the subsequent salvage timber harvest. A Riparian Conservation Objectives analysis indicated that the surveyed streams are presently recovering. Implementation of Alternative 2 would:

Facilitate natural recovery of aquatic features.

Extend the period of time Riparian Conservation Areas would remain in an early seral stage.

Reduce the rate of conifer encroachment into special aquatic features such as meadow/spring complexes.

Foothill Yellow-legged Frog and Western Pond Turtle

Direct, Indirect, and Cumulative Effects

No action is expected to have no effects on the foothill yellow-legged frog and western pond turtle.

Determination of Effects

This alternative would have no effect on the foothill yellow-legged frog or western pond turtle.

Alternative 3

Direct and Indirect Effects

In areas where no planting occurs (800 more acres than Alternative 1), there would be no effect to aquatic and aquatic-dependent species with implementation of Alternative 3. On the remainder of the project area, direct and indirect effects to the aquatic environment would generally be associated with site preparation and release, which would be limited to hand cutting/hand grubbing of shrubs, forbs, and grasses around planted trees. Mechanical methods, such as hand pulling or tarping, would be used to control tall whitetop. Similarly, hand pulling or grubbing, would be used to control yellow starthistle.

The direct and indirect effects to the aquatic system resulting from the implementation of Alternative 3 would generally be limited to herpetofauna mortality due to crushing or smashing during tree planting and release and from mastication equipment in about 388 acres.

With the exception of western pond turtles, aquatic and aquatic-dependent species such as the foothill yellow-legged frog are generally found within 33 feet of water. Thus, in view of the paucity of past herpetofauna observations within the proposed project area, the potential for herpetofauna mortality due to planting activities would minimal, western pond turtles being the exception. Similarly, it is doubtful that hand cutting/hand grubbing would result in herpetofauna mortality. Stream buffers from mastication equipment would reduce the likelihood of crushing within the RCA.

The risk of a large wildfire is the same as Alternatives 2. The potential effects of a large wildfire include a short-term (generally less than five years) degradation of water quality and aquatic habitat in the project area - this in turn can impair downstream beneficial uses of water. The severity and extent of such impacts from large wildfires is highly variable and depends on many factors; some large wildfires result in negligible impacts to water quality, aquatic habitat, and beneficial uses of water.

Cumulative Effects

The hydrologic analysis for the Freds Fire Reforestation Project has determined that in the short-term (<10 years) the recovery of degraded stream channels is slower under Alternatives 1 and 3 than under Alternative 2. In the long-term (>10 years), recovery of degraded stream channels within the project area is nearly the same for all alternatives.

Sediment delivery to stream channels will be slightly greater under Alternatives 1 and 3 during and immediately after storm events in the short-term. In the long-term, there will be a negligible difference between the alternatives.

Under Alternative 3 in some meadow/spring complexes such as Granite Springs, the size of the meadow and the water table may decrease after 25 years.

Foothill Yellow-legged Frog

Direct, Indirect, and Cumulative Effects

Under this alternative, no herbicides would be used, therefore there would not be any expected downstream effects from planting and mastication using stream buffers.

Determination of Effects

Alternative 3 would have no effect on the foothill yellow-legged frog.

Western Pond Turtle

Direct, Indirect, and Cumulative Effects

Direct and indirect effects would generally be limited to mortality due to crushing or smashing during tree planting and release and from mastication equipment on about 388 acres. Stream buffers from mastication equipment would reduce the likelihood of crushing within the RCA

Determination of Effects of Alternative 3

Alternative 3 may impact individuals, but is not likely to cause a trend toward Federal listing or a loss of viability for the western pond turtle.

Aquatic Management Indicator Species

Affected Environment

Management Indicator Species (MIS) for the Eldorado NF are identified in the 2007 Sierra Nevada Forests Management Indicator Species Amendment (USDA 2007b). The MIS Analysis can be found in the Project file. The habitats and ecosystem components and associated MIS analyzed for the project were selected from this list of MIS, as indicated in Table 3-37 (species analyzed for this project are shaded). Category 3 MIS in (aquatic macroinvertebrates), whose habitat would be either directly or indirectly affected, are carried forward and evaluated for direct, indirect, and cumulative effects on the habitat of these species.

Table 3-37. Selection of Aquatic MIS for Project-Level Habitat Analysis for the Fred's Fire Reforestation Project

Habitat or Ecosystem Component	CWHR Type(s) defining the habitat or ecosystem component	Sierra Nevada Forests Management Indicator Species	Category for Project Analysis [1]
Riverine & Lacustrine	lacustrine (LAC) and riverine (RIV)	aquatic macroinvertebrates	3
Wet Meadow	Wet meadow (WTM), freshwater emergent wetland (FEW)	Pacific tree frog *Pseudacris regilla*	2

[1] **Category 1:** MIS whose habitat is not in or adjacent to the project area and would not be affected by the project.
Category 2: MIS whose habitat is in or adjacent to project area, but would not be either directly or indirectly affected by the project.
Category 3: MIS whose habitat would be either directly or indirectly affected by the project.

Habitat/Species Relationship. Aquatic or Benthic Macroinvertebrates have been demonstrated to be very useful as indicators of water quality and aquatic habitat condition (Resh and Price 1984; Karr et al. 1986; Hughes and Larsen 1987; Resh and Rosenberg 1989). They are sensitive to changes in water chemistry, temperature, and physical habitat.

Current Condition of the Habitat Factor(s) in the Project Area: Current conditions are described in Tables 3-25 and 3-26 and "Affected Environment" in Chapter 3 - Aquatic Biology.

Environmental Consequences

Alternative 1 (Proposed Action)

Direct and Indirect Effects to Habitat

The direct and indirect effects to aquatic macroinvertebrates that are considered pertain to flow, sedimentation, changes in temperature regime, and changes in water quality.

Flow: Streamflows down streams flowing into the South Fork American River are not expected to significantly increase as a result of herbicide treatments, hand release, and mastication. Stream buffers should prevent any loss of riparian vegetation along the banks which protect stream flow and bank stability, although herbicide treatments of tributaries shall have smaller buffers or no buffers on ephemerals. This loss of riparian vegetation combined with steep gradient may slightly increase flow during heavy rainfall periods. Where no stream buffers are used for seven acres of yellow-starthistle treatments, the amount of treatment is not expected to increase streamflow significantly.

Sedimentation: Sedimentation is not expected to increase significantly on streams flowing into the South Fork American River as a result of the herbicide treatments, hand release, and mastication. Any change in sedimentation is expected to be minor, and only in the first year with high winter flows. Stream buffers should prevent any loss of riparian vegetation along the banks which protect stream flow and bank stability. Herbicide treatments of tributaries have smaller buffers, or no buffers on ephemerals and on seven acres of yellow-starthistle treatments. These smaller buffers increase the likelihood of riparian vegetation being affected. Combined with their steep stream gradient, herbicide treatment near these smaller tributaries may cause an increase sedimentation during the heavy rainfall periods, especially during the first winter after treatment.

Temperature: Temperature is not expected to increase as a result of the herbicide treatments on the streams flowing into the South Fork American River. Stream buffers should prevent any loss of riparian vegetation along the banks; the riparian vegetation provides shade which prevents the water from warming. Herbicide treatments of tributaries shall have smaller buffers or no buffers. This loss of riparian vegetation combined with steep gradient may warm water temperatures over small stretches. These sections are short and not expected to warm streams significantly. Where no stream buffers are used for seven acres of yellow-starthistle treatments, the amount of treatment is not expected to reduce stream shade.

Water Quality: Water quality is not expected to change significantly as a result of the herbicide treatments on the streams flowing into the South Fork American River. Stream buffers should prevent any contamination of these streams by herbicides moving off-site, being mobile, or flushing during rainstorms (refer to Tables 3-31 through 3-35, and the narratives thereafter for each herbicide, surfactant, and dye describing effects to aquatic species, including invertebrates). Where no stream buffers are used for seven acres of yellow-starthistle treatments, the herbicide, surfactant, and dye to be used is of the lowest toxicity available, and not expected to have significant direct effects and reduce macroinvertebrate populations in the adjacent streams. If herbicide were to enter streams, it is possible that reductions in algae may reduce food supply and indirectly affect those macroinvertebrates that depend on grazing of algae. These aquatic invertebrates would quickly recolonize the following year from upstream locations when algae returned to the stream. Water quality is not expected to change as a result of mastication and hand release treatments because of stream buffers, unless petroleum products leaked from heavy equipment use, which is not likely. Fueling of equipment shall not occur near streams (BMP 2-12).

Cumulative Effects to Habitat in the Project Area

The cumulative effects analysis for aquatic macroinvertebrates considers the effects of this project when combined with past, present, and foreseeable future actions and events. Past land disturbances within the proposed project area were considered if they had the potential to influence species population dynamics and/or potential habitat. Similarly, future land disturbances were considered based on their probability of influencing species populations and/or aquatic community components. Due to the uncertainty regarding future anthropogenic disturbance in the affected watershed, the temporal scale for this analysis is limited to approximately 10 years.

Refer to past, present, and foreseeable future cumulative effects for herpetofauna in Chapter 3 - Aquatic Biology. Most of these cumulative impacts also pertain to aquatic invertebrates.

Alternative 2 (No Action)

Direct and Indirect Effects to Habitat

There would be no direct or indirect effects to aquatic and/or macroinvertebrates. The risk of a large wildfire in the project area might be greater under Alternative 2 than under Alternative 1 (Proposed Action). The potential effects of a large wildfire include a short-term (generally less than five years) degradation of water quality and sedimentation, and an increase in streamflow and water temperature in the project area - this in turn can impair downstream beneficial uses of water. The severity and extent of such impacts from large wildfires is highly variable and depends on many factors; some large wildfires result in negligible impacts to water quality, aquatic habitat, and beneficial uses of water.

Cumulative Effects

Presently within the Freds Fire Reforestation Project area, aquatic features are recovering from two recent disturbances, the Freds Fire of October 2004 and the subsequent salvage timber harvest. A Riparian Conservation Objectives analysis indicated that the surveyed streams are presently recovering. Implementation of Alternative 2 would facilitate natural recovery of aquatic features and extend the period of time Riparian Conservation Areas would remain in an early seral stage.

Alternative 3

Direct and Indirect Effects to Habitat

Direct and indirect effects to the aquatic system from tree planting and release and from mastication equipment is not expected to significantly change streamflow, water quality, sedimentation or water temperature. Any increase in sedimentation is expected to be minor. The stream buffers of heavy equipment from the streams should prevent any adverse effects downstream. The risk and effects of a large wildfire is the same as Alternative 2.

Cumulative Effects

The hydrologic analysis has determined that the recovery of degraded stream channels, both short and long term, is similar for all alternatives. Sediment delivery to stream channels may be slightly greater under Alternatives 1 and 3 during and immediately after storm events in the short-term. There will be a negligible difference between the alternatives in the long-term.

Summary of Aquatic Macroinvertebrate Status and Trend at the Bioregional Scale

The ENF LRMP (as amended by the SNF MIS Amendment) requires bioregional-scale Index of Biological Integrity (IBI) and Habitat monitoring for aquatic macroinvertebrates. This information is drawn from the detailed information on habitat and population trends in the Sierra Nevada Forests Bioregional MIS Report (USDA 2008b), which is hereby incorporated by reference. The data collected at the Bioregional scale indicate that the IBI metrics for macroinvertebrates are stable.

Relationship of Project-Level Habitat Impacts to Bioregional-Scale Aquatic Macroinvertebrates Habitat Trend

The Fred's Fire Reforestation Project would not alter the existing trend in the habitat or aquatic macroinvertebrates across the Sierra Nevada bioregion. Changes in sedimentation are expected to be very minor, and only in the first year. Water quality could be slightly affected if herbicides enter streams and caused a reduction in algae, which is food for grazing aquatic invertebrates. The aquatic invertebrates would quickly recolonize the following year when algae returned to the stream. There is not expected to be a significant change in streamflow or shade because of the BMPs used in the project design. Thus, the project would not alter the existing trend in the habitat or aquatic macroinvertebrates across the Sierra Nevada bioregion.

Terrestrial Wildlife

Affected Environment

Wildlife species are discussed in detail in the terrestrial Biological Evaluation (BE), Biological Assessment (BA), and Management Indicator Species (MIS) Report. These documents can be found in the project file. This section summarizes these documents.

The wildlife habitat in the project area will be discussed utilizing California wildlife habitat relationship (CWHR) types described in "A Guide to Wildlife Habitats of California" (Mayer and Laudenslayer 1988). The Freds Fire Reforestation Project area is predominately comprised of Sierra mixed conifer in a variety of seral stages with pockets of hardwood-conifer, montane hardwood, Jeffrey pine, red fir and montane chaparral dispersed throughout the areas. Stringers of montane riparian CWHR type are found along perennial creeks and tributaries.

The Freds Fire created a mosaic of dead and live trees; resulting in early seral habitat dominated by standing dead trees, particularly in high intensity burn areas. Areas of moderate and high fire intensity had significant tree mortality, and these areas changed from mid- and late-seral forest conditions to early-seral forest conditions. Areas of low fire intensity had very little tree mortality and reflect conditions of an understory burn in which ground fuels were removed but canopy cover remained relatively unchanged.

In stands that experienced low to moderate fire intensities, a live conifer overstory remains; however, some large trees may continue to die due to cambial kill. In these areas, the CWHR type remained the same, but the tree size and/or canopy closure designation changed. For example, in stands that were estimated to be CWHR type Sierran Mixed Conifer (SMC) 5M (Table 3-38) before the fire; after the fire they may be measured as SMC 4P because the loss of large trees lowered the average DBH and canopy closure of the stand. In areas where canopy closure fell below 40%, a shrub understory continues to develop.

Table 3-38. California Wildlife Habitat Relationship (CWHR) Types

CWHR Size Class*	CWHR Size Class Description	
	DBH (inches)*	Percent Canopy Closure
3P	6-12	20-40
3M	6-12	40-60
3D	6-12	>60
4P	12-24	20-40
4M	12-24	40-60
4D	12-24	>60
5P	>24	20-40
5M	>24	40-60
5D	>24	>60
6	>24	>60%, multi-layer canopy

*defined by average tree size

Over time, post-fire habitats develop through a variety of successional stages. During the first five years following a fire, herbaceous habitats tend to dominate in areas where fire intensities were high (Mayer and Laudenslayer 1988). Forbs and sprouting shrubs form a mosaic, with areas of open ground with remaining post-fire salvage snags providing structural diversity. Two-thirds of the remaining post-fire snags less than 10” DBH may have fallen by year five, but most larger snags remain standing. Within 15 years, shrubfields (montane chaparral CWHR type) dominate the area (USDA 2001b). Shrubs form a relatively dense canopy, shading out most forbs. Most snags less than 16” dbh will typically have fallen, along with about one-half of snags 16”-24” dbh (Barnhart 2002). Small openings in the shrub cover may be created where snags fall and inhibit growth. Montane chaparral will likely persist for at least 50 years before conifers begin to shade out the brush (Mayer and Laudenslayer 1988) and hardwoods, dependent on site conditions. At that time, most post-fire salvage snags will have fallen, with the exception of about one-half of those greater than 40” dbh (Barnhart 2002).

Snags will continue to be recruited over time as remaining trees that were weakened by the fire continue to die. Mixed Hardwood Conifer (MHC) and Montane Hardwood Woodlands (MHW) are expected to continue to increase in number and size of trees due to the open canopy and lack of current competition with large conifers. However, once conifers re-establish themselves, oaks will start to be shaded out, as the canopy increases in density.

Federally Endangered, Threatened, or Proposed Species

Pursuant to Section 7(c) of the Endangered Species Act of 1973 as amended, the USFWS has provided a list of threatened, endangered, proposed, and candidate species that may be present on the ENF (USDI, 2009). The latest species list for the Eldorado National Forest was dated January 29, 2009 and obtained on April 2, 2009. The updated USDI Fish and Wildlife list for the ENF is available for review at http://sacramento.fws.gov/es/spp_lists/NFActionpage.cfm. No critical habitat for any terrestrial wildlife species has been identified on the Forest (Ibid). The valley elderberry longhorn beetle (threatened) is the only terrestrial species provided by the USFWS as potentially occurring on the ENF. Based on the existence of suitable habitat within the analysis area, this section considers the potential effects of the proposed Freds Fire Reforestation Project on the federally listed threatened wildlife species shown in Table 3-39.

No federally threatened, endangered or proposed species or their habitat would be impacted by the project. The project is above the elevational range for the threatened valley elderberry longhorn beetle (Table 3-40).

Sensitive Species

Thirteen species have been identified for the ENF from the Regional Forester's list of Sensitive Species for Region 5 (Table 3-39) (USDA 1998b).

Table 3-39. Federally Listed or Region 5 Designated Sensitive Terrestrial Species on the ENF

Federally Listed and Proposed Species	
Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*)	Threatened
Region 5 Sensitive Species	
California spotted owl (*Strix occidentalis occidentalis*)	Pallid bat (*Antrozous pallidus*)
Northern goshawk (*Accipiter gentilis*)	Townsend's big-eared bat (*Corynorhinus townsendii*)
American peregrine falcon (*Falco peregrinus*)	Western red bat (*Lasiurus blossevilli*)
Great gray owl (*Strix nebulosa*)	Willow flycatcher (*Empidonax trailli*)
Sierra Nevada red fox (*Vulpes vulpes necator*)	Pacific fisher (*Martes pennanti pacifica*)
American marten (*Martes americana*)	California wolverine (*Gulo gulo luteus*)
American bald eagle (*Haliaeetus leucocephalus*)	

The Freds Project analysis area is defined as the project boundary, associated project units and a 1.5 mile buffer from the project boundary (as part of the cumulative effects analysis area) for species that may be in the area and that have a potential to be impacted by the proposed project. The project area has been evaluated for threatened and sensitive wildlife by consulting the Forest geographic information system (USDA 2009a) and considering literature in the species information files (USDA 2009b). Based on the existence of suitable habitat within the analysis area, Table 3-40 examines the potential for occurrence of the Region 5 sensitive species, and identifies the species that will be further analyzed. Species that may be affected by activities proposed by this project are shaded.

Direction to maintain the viability of Region 5 sensitive species is provided by the National Forest Management Act, the Code of Federal Regulations (219.19), the Forest Service Manual (2672), and the Eldorado National Forest Land and Management Plan (LRMP). The Sierra Nevada Forest Plan Amendment (SNFPA) Final Supplementary Environmental Impact Statement (SEIS) Record of Decision (USDA 2004b) amends the Eldorado National Forest LRMP. The BE determined that for the northern goshawk, great gray owl, American peregrine falcon, willow flycatcher, Sierra Nevada red fox, Pacific fisher, American marten, California wolverine, and American bald eagle, the project area is either outside the elevational range or lacks habitat for those species and, therefore, will not be affected by the proposed project (Table 3-40).

Table 3-40. Project Assessment for Species Occurrence

Species	Potentially Affected Suitable Habitat Within the Project Area	Suitable Habitat Not Available or Not Affected within the Analysis Area	Potential for Disturbance	Considered for Further Analysis
Valley elderberry longhorn beetle	No	Project units are above 3,000 feet in elevation, above the species elevational range. No habitat will be affected.	No	No
California Spotted Owl	Though remnant habitat occurs for spotted owls within the Freds Fire boundary no suitable habitat in the form of late seral habitat components (snags, down logs, large trees) will be treated under this project.	Suitable habitat will not be affected by project activities; however; indirect effects will be analyzed in regards to future habitat development.	No - Mitigations in the form of Limited Operating Periods (LOPs) will avoid or minimize disturbance to nesting spotted owls.	Yes
Pallid Bat, Townsend's Big-Eared Bat	Project area contains mixed age conifer and hardwood forest, brush, large snags and down logs	N/A	Yes	Yes

Species	Potentially Affected Suitable Habitat Within the Project Area	Suitable Habitat Not Available or Not Affected within the Analysis Area	Potential for Disturbance	Considered for Further Analysis
American Peregrine Falcon	Sugarloaf rock formation provides potential nesting habitat. No cliff habitat will be affected.	N/A	No	No
Great gray owl	No	Project area does not contain suitable large meadow habitat characteristics	No	No
California wolverine	No	Sub-alpine habitat absent from project area. High human disturbance. High level of roads/campsites/ fragmentation.	N/A	No
Willow flycatcher	No	Wet meadow complexes preferred by this species, absent within the project area.	No	No

Source: USDA 2009b

California Spotted Owl

The ENF occurs in the central portion of the species range and represents about 16 percent of the known population in the Sierra Nevada. There is a relatively uniform distribution of owl sites across the Forest and adjoining the Tahoe National Forest to the north and Stanislaus National Forest to the south. The 2001 SNFPA FEIS, (USDA 2001b, Vol. 3, Ch. 3, part 4.4, pg. 69-82), and the 2004 SNFPA FSEIS, (USDA 2004b Vol. I, Ch. 3, pg. 142-147), summarizes the information regarding the biology and status of the California spotted owl. Since then, the ENF species account and the ENF MIS report for spotted owls have been updated (USDA, 2007c, Lipton et al. 2007). These reports were reviewed for this analysis and are incorporated by reference.

On February 14, 2003, the USFWS announced its finding that listing of the California spotted owl was not warranted at this time (Federal Register 2003). The USFWS found that "there is no substantive information that indicates that there are significant or immediate threats to California spotted owl viability because of the lack of regulatory mechanisms." On June 21, 2005, the USFWS announced that the California spotted owl is being reviewed for potential listing, primarily based on habitat loss and competition with the barred owl, which has expanded its range (Federal Register 2005); however, the May 24, 2006 USFWS decision was not to warrant the California spotted owl for listing (Federal Register 2006). Their finding was based on the following factors: 1) best available data (Blakesley et al. 2006, in Federal Register 2006) indicate populations are stationary throughout the Sierra with no strong evidence of declining trend; 2) planned and currently implemented fuels reduction projects will benefit owl habitat in the long-term by reducing risk of loss due to catastrophic wildfire; 3) survey data for the San Bernardino spotted owl population do not show statistically significant declines and barred owls represent only 2 percent of spotted owl numbers in the Sierras; and 4) the largest private land owner, Sierra

Pacific Industries, offers protection of spotted owls by surveying for the species, implementing a no cut buffer around territory centers, and no harvest of units with nesting owls. The USFWS recognized that there are short term risks of effects of fuels treatments on spotted owl habitat to gain the long term benefit of reduced wildfire and that potential threats of wildfire and barred owl range expansion still exist, therefore, the agency will continue to monitor the status of the species (Federal Register 2006).

A recent meta-analysis of demographic study results for California spotted owl populations in the Sierras was conducted to perform a status review of the species by the USDI Fish and Wildlife Service in 2005 and early 2006. This review found that most populations (including the population studied on the ENF) demonstrated an increasing or stationary trend and that there was no strong evidence for decreasing trends on any of the study areas (Federal Register 2006). The ENF currently manages habitat for over 200 spotted owl territories, but the proportion of these territories that are occupied at any one point in time is unknown with the exception of the Eldorado study area demographic work research. The Eldorado Density Study (63% on ENF, 37% on private) and a portion of the Regional Study Area (58% of the owl territories) occur on the ENF, in El Dorado and Placer Counties, overlapping the Pacific and Georgetown Ranger Districts. The 2007 Annual Results reported "after two poor reproductive years on the Eldorado study area in 2005 and 2006, reproduction rebounded sharply this past breeding season" (Gutierrez, et al. 2008). Though milder weather conditions have provided better nesting success and fledgling survival, the study also indicated that "the population rate of change on the Eldorado Density Study Area indicated that lambda for population of territorial owls has gradually declined over the course of our study" (Ibid 2008). The conclusion for the report mentions monitoring should continue to enable research to assess "if changes in owl populations are the result of natural events or management-induced changes in forest composition and structure as the Forest Service moves forward in implementing fuels treatments under the 2004 Sierra Nevada Amended Framework" (Ibid 2008).

The reproductive season for spotted owls occurs between mid-February and August with most young fledging by August 31 (Verner et al. 1992). According to the literature regarding productivity and survivorship of spotted owls, there is a direct relationship between the amount of high quality habitat (greater than 50% canopy closure) in close proximity to the nest stand and reproduction (Verner et al. 1992). There are currently two Protected activity Centers (PACs) within the project area boundary.

PAC ED_139 only had a portion of the PAC burned by the fire. The historic activity center for this PAC was unaffected by the Freds Fire due to its location south of the American River, outside the fire perimeter. PAC habitat lost for ED_139, within the fire area, has been replaced with available Home Range Core Area (HRCA) acreage south of the river, outside the fire, and closer to the historic activity center. PAC ED_103 had the majority of the PAC and HCRA burned. Portions of the habitat occur outside the burn area and within residual live tree pockets in the burn area. PAC_103 and HRCA has been redrawn to incorporate remaining habitat near the historic activity center and also outside the burn area.

Surveys were conducted to relocate owls found in the Freds Fire area in 2005. Table 3-41 gives the status of those owl territories directly affected by the fire, as well as current and historical survey efforts. Surveys will be conducted in late spring/early summer in 2009 to assess current spotted owl occupancy status associated with PACs ED-103, and ED-139.

Table 3-41. Spotted Owl Protected Activity Centers within the Freds Fire Area

PAC	Best Status/Year	Last Status/Year
ED_103	Pair, 2 Young/2000	Adult male, 2007
ED_139	2 Young, 2005	Pair, 2006

Source: USDA 2009

Habitat Relationships

Suitable spotted owl habitat in the Sierra Nevada consists of dense, multi-layered mature forested stands with greater than 70% canopy closure preferred for nesting and greater than 50% canopy closure for foraging (Verner et al. 1992). Also important is availability of large snags and down logs, which are utilized for nesting and support the owl's prey base of mainly flying squirrels and woodrats (Laymon 1988). On the Forest, spotted owls are known to occur between 2,000 feet and 7,200 feet in elevation, with most of the nesting pairs found in the Sierra mixed conifer habitat type.

Approximately 84% of 292 California spotted owl nest vegetation plots were classified as CWHR classes 6, 5D, 5M, 4D, and 4M (USDA 2001b). These CWHR types are also rated as providing high and moderate suitability foraging habitat for California spotted owls based on the expert opinion habitat relationship models contained in the CWHR database. The majority of spotted owl nest sites have been documented to occur in CWHR classes 6, 5D, and 5M. It would be expected, therefore, that CWHR classes 6, 5D, and 5M would have the highest probability of providing stand structures associated with preferred nesting, roosting, and foraging (USDA 2001b).

Historical and current spotted owl habitat conditions within the Freds Fire

Spotted owl habitat remains broadly distributed on the ENF, however, temporary habitat gaps have been created in the areas burned by the Cleveland, Fred's and Star Fires on the ENF. A geographic area of concern, mapped as the large areas of intermixed and checkerboard land ownership on the Georgetown and Pacific Ranger Districts, has been identified as an area where suitable habitat appears to be fragmented and in low abundance as the result of past and ongoing timber harvest. Within this area, the lower density of spotted owl pairs increases the uncertainty of successful mate finding and replacement of vacated territories (Verner, et al. 1992).

The impacts of catastrophic fire on spotted owl survival and reproduction is unclear. From what we do know about spotted owl biology of preferring unfragmented areas with large trees and dense canopies centered around their activity center (Verner et al 1992, Bart 1995), one could infer that destruction of these elements by wildfire would have a negative effect on owl survival and reproduction. The loss of habitat due to catastrophic fire was listed as one of the major threats to spotted owl habitat in the Sierra Nevada (Verner et al. 1992). Gaines et al. (1997) reported that northern spotted owls were not observed returning after Hatchery Complex fires in Washington. In the Marble-Cone fire in California and following the 1994 fires on the Yakima Indian Reservation in south-central Washington, spotted owls either abandoned their habitat or avoided areas that experienced stand-replacement fire (Elliott 1985, Bevis et al. 1997, in Smith 2000).

Research from spotted owl demography study areas throughout the species range (northern, California, and Mexican subspecies) attempted to determine the short-term (1-year) effects of fire on four factors: 1) minimum survival, 2) site fidelity, 3) mate fidelity, and 4) reproductive success (Bond et al. 2002). The study looked at fires greater than 1,340 acres in which known owl nest and roost sites from one of three Demographic Studies were burned. Out of greater than 300 territories, eleven met the criteria (4 northern, 3 California, and 4 Mexican). Fire severities were mapped at 8 of the 11 territories, with half of the eight burning primarily at low to moderate severity. In the remaining four territories, 36-88% of the territory burned at high severity. Both minimum survival (defined as surviving at least one year after the fire) and site fidelity were found to be similar to overall estimates for the three sub-species for spotted owl (Bond et al. 2002). Four of the seven owl pairs found produced young the year following the fire (Bond et al. 2002). Caution should be exercised when making conclusions about reproduction because differences could be from year-to-year variation and not as a result of the fire (Bond et al. 2002).

Telemetry studies in the Timbered Rock Fire in 2004, in southwestern Oregon, showed use of post-fire habitat by owls in moderate to high severity burn areas (Andrews and Anthony 2004). The ENF assumes that the type of habitat utilized by spotted owls would be similar before and after a fire, with foraging habitat occurring in forested habitat with greater than 50% canopy closure and nesting habitat having greater than 70% canopy closure. However, preliminary results from the Timbered Rock Fire, documented approximately 19% of all owl locations were within high-severity burned areas during the winter season one year post-fire (Andrews and Anthony 2004). Given that owls appeared to be using moderately to heavily burned forests, they suggested a cautious approach to salvage on the study area, but due to the small sample size and uncertainty about the accuracy of the fire severity mapping, the authors considered their results “exploratory and preliminary. The Timbered Rock Fire telemetry study states that fire severity ratings were not field verified and would be done as part of an expanded study effort. It was unclear if BAER severity ratings for watershed were used or intensity ratings in regard to tree mortality to determine the severity ratings for the Timbered Rock Fire, and due to this, comparisons to the Freds Fire were limited. However, it does show more information is needed from these and future studies, on where and for how long owls may utilize post-burn areas, as well as a consistent approach to mapping post-burn habitat and tree mortality.

Suitable habitat has been mapped for spotted owls on the forest, based on vegetation that meets the suitable habitat described in the Sierra Nevada Forest Plan Amendment (USDA 2001b). Habitat is represented by CWHR types 4M, 4D, 5M, and 5D. Mortality of the partial green stands in the project area was split into three categories based on residual green trees. High mortality was defined as stand replacing, or stand replacing with inclusions of scattered clumps of green trees under 10 acres. Moderate intensity was not stand replacing, had green residual remaining, and had a mosaic of variable burn intensities. Low mortality had minimal mortality within the stands and exhibited conditions similar to that of an understory burn. Based on mortality estimates (Smith 2001), approximately 332 acres (>75% mortality class) remain scattered across the landscape, based on green tree mapping, within the moderate and high intensity burn areas. This is an over-estimate of live trees remaining to contribute to suitable or potential future habitat as trees may continue to die from the fire or insect damage within 1-2 years. It is unlikely that the scattered remaining habitat would provide long-term support to a breeding pair of owls; however, it may be important for dispersal in the future. Low mortality had minimal mortality within the stands and exhibited conditions similar to that of an understory burn and still provides habitat, primarily within PAC ED_139 (Table 3-42).

Table 3-42. Existing Suitable Habitat in Freds Project Area Boundary still Available for Owl Use

Existing Habitat within Freds Fire	Existing Acres	Suitable Habitat Acres Proposed for Treatment	Affected Acres of Existing Habitat	Existing Habitat Post-Project	PAC Overlap	HCRA Overlap
Low Intensity Burn	285 acres	0 acres	0	285 acres	ED-139	ED-139
Moderate and High Intensity Burn	332 acres, scattered	0 acres	0	332 acres, scattered	ED-103	ED-103

Pallid Bat

Throughout California, the pallid bat is usually found in low to middle elevation habitats below 6,000 feet (Philpott 1997); however, the species has been found up to 10,000 feet in the Sierra Nevada (Sherwin 1998). Pallid bats are most common in open, dry habitats that contain rocky areas for roosting. They are a yearlong resident in most of their range and hibernate in winter near their summer roost (Zeiner et al. 1990). Day roosts may vary but are commonly found in rock crevices, tree hollows, mines, caves and a variety of human-made structures. Tree roosting has been documented in large conifer snags, inside basal hollows of redwoods and sequoias, and bole cavities in oaks (Sherwin 1988). There is a strong association with roosting in black oak cavities (Pierson 1996) for pallid bats. Maternal roosts are typically colonies (usually between 20 to several hundred individuals). Breeding occurs between May and July, with young weaned in mid-late August USDA 2009b) and maternity colonies breaking up by mid-October (Barbour and Davis 1969, in USDA 2009b). Little is known about the winter habits of this species although it is thought to winter near the summer roost sites (Ibid). Pallid bats forage near and at ground level. Pallid bats are known to feed predominately on ground-dwelling arthropods, such as scorpions and Jerusalem crickets (USDA 2001b). Foraging occurs over open ground, where pallid bats are more often found along edges and open stands, particularly hardwoods (USDA 2001b).

Townsend's Big-Eared Bat

The Townsend's big-eared bat occurs throughout the west. In California, the species is typically found in low desert to mid elevation montane habitats, although sightings have been reported up to 10,800 feet (Philpott 1997, Sherwin 1998, in USDA 2009b). Habitat associations include desert, native prairies, coniferous forests, mid-elevational mixed conifer, mixed hardwood-conifer forests, riparian communities, active agricultural areas and coastal habitat types (Kunz and Martin 1982, Brown 1996, Sherwin 1998, in USDA 2009b). Populations have incurred serious declines over the past 40 years in parts of California (Brown 1996, in USDA 2009b). Foraging usually begins well after dark (Kunz and Martin 1982, in USDA 2009b). Foraging associations include edge habitats along streams and areas adjacent to and within a variety of wooded habitats (Sherwin 1998, in USDA 2009b). In California, the species is shown to forage preferentially in association with native vegetation (Brown 1996, in USDA 2009b). Flight is slow and maneuverable, with the species capable of hovering (Zeiner et al. 1990) and gleaning insects off foliage (Brown 1996, in USDA 2005b). The Townsend's big-eared bat is a moth specialist, with provided by riparian habitat, black oak, large snags, and rock outcrops scattered throughout the project area. It is likely that some of these habitat features may hold either or all: hibernaculum, maternity or basic roost sites for bat species RCAs containing larger deciduous trees also occur within the project area. Areas containing large deciduous trees are variable within the length of the RCAs.

Environmental Consequences

Federally Endangered, Threatened, or Proposed Species

No federally listed threatened, endangered, or proposed terrestrial wildlife species or their habitat will be affected by this project. Therefore, there would be no impacts from any of the alternatives in this project to such species.

Alternative 1 (Proposed Action)

Toxicological Effects- All Species

As previously described, the BE determined that the valley elderberry longhorn beetle (threatened), and sensitive species northern goshawk, great gray owl, American peregrine falcon, willow flycatcher, Sierra Nevada red fox, Pacific fisher, American marten, California wolverine, and American bald eagle will not be affected by the proposed project. Potential exposure to herbicides to terrestrial wildlife species considered for further analysis includes California spotted owl, pallid bat, Townsend's big-eared bat, and western red bat.

Five herbicides are proposed under this alternative: Glyphosate, triclopyr BEE, hexazinone, clopyralid, and chlorsulfuron. The Final Environmental Impact Statement for Reforestation (USDA 1989b) (page 4-43) describes the following risks to bird and mammal species associated with use of glyphosate, triclopyr, and hexazinone, along with 8 other herbicides:

"Comparison of the bird and mammal doses to the laboratory lethal levels indicates that there is little chance of any direct mortality from herbicide exposures in the Region 5 program for these 11 herbicides. They are all far lower than the 1/5 LD_{50} criterion of EPA (1986). Under worst case circumstances where an individual animal is sprayed and consumes only contaminated diet items, there would be a risk of fatality or severe effects from the herbicides, but this is highly unlikely. Only under extremely rare circumstances would an animal be likely to be seriously affected in a spraying operation."

The ecological risks of various formulations of glyphosate, triclopyr, hexazinone, clopyralid, and chlorsulfuron; are described in ecological risk assessments prepared for the Forest Service by Syracuse Environmental Research Associates, Inc. (SERA 1996a, 1997a, 1999, 2003a, 2003b, 2004a, 2004b, and 2005). Assessments have also been completed for the use of dyes and Nonylphenol Polyethoxylate-based (NPE) surfactants (SERA 1997b, USDA 2003a). These assessments and a more detailed discussion of toxicological effects presented in the project environmental analysis are incorporated by reference and form the basis for the following analysis. The Herger-Feinstein Quincy Library Group Supplemental EIS (USDA 2003b) provides detailed information on the effects of herbicide use on terrestrial wildlife and is also incorporated by reference, as is USDA 2007a, updated information in regards to surfactants.

Estimated exposure doses for terrestrial species are based on the planned herbicide application rates for this project and are located in the project file. They follow the same methodology as the Site-Specific Human Health Risk Assessment (Appendix D). They are based on USDA (2003) and the SERA Risk Assessments.

Studies on surrogate species were utilized when species specific information was not available. For this project, a surrogate species for bats, a small mammal, is used as a surrogate for direct spray. A small bird eating contaminated insects is used as a surrogate for a bat eating contaminated insects. A carnivorous bird eating a small mammal is used as a surrogate for a spotted owl eating contaminated prey.

To quantitatively characterize risk a hazard quotient is calculated. The quantitative risk characterization is expressed as the hazard quotient, which is the ratio of the estimated exposure doses to the NOAEL. Tables 3-43 through 3-47 provide a summary of the risk characterization.

Clopyralid

Clopyralid has been tested on a limited number of species and under conditions that may not well-represent populations of free-ranging non-target animals. However, clopyralid appears to be relatively non-toxic to terrestrial animals, and the weight of evidence suggest that no adverse effects in terrestrial animals are plausible using typical or even very conservative worst case exposure assumptions (SERA 2004b). For terrestrial mammals, the dose-response assessment for clopyralid is based on the same data as used in the human health risk assessment (i.e. an acute NOAEL (no observed adverse effects level) of 75 mg/kg/day and a chronic NOAEL of 15 mg/kg/day). None of the exposure scenarios, acute or longer term, resulted in exposure estimates that exceed this NOAEL. The very limited data on toxicity to birds suggest that birds may be somewhat more sensitive than mammals. Nonetheless, there is no indication that clopyralid is highly toxic to birds (SERA 1999). A comparison of gavage studies between mammals and birds suggest that birds may be more sensitive than mammals. However, based on a comparison of short-term dietary NOAELs, birds appear to be somewhat less sensitive, with an acute dietary NOAEL of about 670 mg/kg/day. Since most of the exposure assessments developed in this risk assessment involve gradual intake during the day, the dietary NOAEL of 670 mg/kg/day is used for the risk characterization in birds (SERA 2004b). Clopyralid was characterized in the HFQLG Supplemental EIS (USDA 2003b) as "slightly to practically non-toxic to birds; practically non-toxic to fish and aquatic invertebrates".

The Site-Specific Risk Assessment analysis conducted for the Freds Fire Reforestation Project showed that no exposure scenario at any level (acute or chronic) exceeds the NOAEL (Table 3-43).

Table 3-43. Summary of Hazard Quotients for Terrestrial Wildlife – Clopyralid

Summary of Risk Characterizations at Highest Application Rate (2.4 lbs/acre)						
Receptor	Scenario	Hazard Quotients			Toxicity Values (mg/L)	Toxicity Endpoint
		Central	Lower	Upper		
Acute/Accidental Exposures						
Direct Spray						
first-order absorption	Small mammal	1E-03	3E-04	6E-03	75	NOAEL
100% absorption	Small mammal	0.08	0.08	0.08	75	NOAEL
100% absorption	Honey Bee	0.04	0.04	0.04	909	NOAEL
Contaminated Insects						
	Small Bird	0.01	0.01	0.042	670	NOAEL
Consumption of contaminated small mammal						
	Carnivorous bird	1E-03	1E-03	1E-03	670	NOAEL
Chronic/Longer-term Exposures						
Consumption of contaminated fish						
chronic	Fish-eating bird	1E-05	8E-07	3E-05	15	NOAEL

Glyphosate

A risk assessment was completed for the use of glyphosate by the Forest Service in vegetation management in 2003 (SERA 2003a). The analysis reviewed available studies for any "specific toxicities that would occur in birds as compared to mammals and found suggestive evidence that glyphosate may inhibit phosphorylation and consequently reduce food conversion efficiency" in mammals and birds; however; they also found glyphosate has an apparent lack of teratogenic activity in birds (SERA 2003a).

This herbicide is generally not known to bioaccumulate in an animal's fatty tissue (SERA 2003a), therefore, secondary adverse impacts to a species preying on an animal that had been directly exposed to glyphosate is not expected.

Based on the available field studies of the effects of glyphosate on terrestrial animals, at the application levels proposed "direct toxic effects are unlikely. The effects on terrestrial animals appear to be secondary to changes in habitat resulting from toxic effects on vegetation (SERA 1996a)." Glyphosate was characterized in the HGQLG Supplemental EIS (USDA 2003b) as "practically non-toxic to mammals, birds, bees, aquatic invertebrates; slightly toxic to fish." A summary of SERA 2003a for terrestrial organisms shows that, at the typical application rate of 2 lbs a.e./acre, none of the hazard quotients for acute or chronic scenarios reach a level of concern, even at the upper ranges of exposure for terrestrial organisms. For the application rate of 7 lbs a.e./acre, central estimates of the hazard quotients, the level of concern is exceeded modestly in acute scenarios for a large mammal consuming contaminated vegetation and a small bird consuming insects. In the chronic exposure scenarios, the hazard quotient for a large bird consuming contaminated vegetation on site exceeds the level of concern by a factor of about 3. As with all longer term exposure scenarios involving the consumption of contaminated vegetation, the plausibility of this exposure scenario is limited because damage to the treated vegetation - i.e., vegetation sprayed at the highest application rate -would reduce and perhaps eliminate the possibility of any animal actually consuming this vegetation over a prolonged period (SERA 2003a). The direct spray of a honey bee at an application rate of 7 lbs a.e./acre corresponds to a dose of 1120 mg/kg bw. It is unclear is this would be associated with detectable toxic effects. Based on the study by Palmer and Krueger (2001a, in SERA 2003a), a dose of 100µg/bee, corresponding to about 1080 mg/kg bw, was associated with 5% mortality (3/60). It should also be noted that this risk characterization applies only to bees that are directly sprayed at the maximum application rate (7 lbs/acre) and does not consider the effects of foliar interception. Thus under actual field conditions, substantial mortality in bees would not be expected (SEAR 2003a).

The Site-Specific Risk Assessment analysis conducted for the Freds Fire Reforestation Project (Table 3-44) showed that effects to birds, mammals and invertebrates are similar to SERA 2003a. The highest rate proposed on this project (4.8 lbs/acre (versus 7 lbs/acre in SERA 2003a)). reduces risk. As bats have the potential to be exposed through direct exposure or through eating contaminated insects, a surrogate species for bats, a small mammal, is used as a surrogate for direct spray. A small bird eating contaminated insects is used as a surrogate for a bat eating contaminated insects. The small mammal being sprayed is below a level of concern, even under a 100 percent absorption scenario. A small bird eating contaminated insects modestly exceeds the level of concern (HQ =1) at the upper level of exposure. This scenario may be extremely conservative as it assumes that 100% of the insects consumed by the bird on the day of exposure (i.e, no dissipation is assumed) were directly sprayed. As spotted owls have the potential to be exposed through eating contaminated prey, a carnivorous bird eating a small mammal is used as a surrogate. This acute scenario is well under the level of concern (HQ = 0.03). The acute dose received (15.5 mg/kg bw) is also a factor of 6 below the chronic NOAEL of 100 mg/kg/bw/day.

Table 3-44. Summary of Hazard Quotients for Terrestrial Wildlife – Glyphosate

Summary of Risk Characterizations at Highest Application Rate (4.8 lbs/acre)						
Receptor	Scenario	Hazard Quotients			Toxicity Values (mg/L)	Toxicity Endpoint
		Central	Lower	Upper		
Acute/Accidental Exposures						
Direct Spray						
first-order absorption	Small mammal	7E-03	2E-03	0.02	175	NOAEL
100% absorption	Small mammal	0.7	0.7	0.7	175	NOAEL
100% absorption	Honey Bee	**1.4**	**1.4**	**1.4**	540	NOAEL
Contaminated Insects						
	Small Bird	0.3	0.3	**1.0**	562	NOEC
Consumption of contaminated small mammal						
	Carnivorous bird	0.03	0.03	0.03	562	NOAEL
Chronic/Longer-term Exposures						
Consumption of contaminated Fish						
chronic	Fish-eating bird	2E-06	1E-07	3E-05	100	NOAEL

Hexazinone

Effects to animals from hexazinone is dependent on the formulation utilized (granular or liquid) according the risk assessment on hexazinone conducted for the Forest Service (SERA 2005).).

Under this project, only granular formulations are proposed. The toxicity of hexazinone to terrestrial wildlife, particularly invertebrates, is not well characterized. Therefore, the assessment of effects on terrestrial species is based primarily on the available data on experimental mammals. "Based on dietary toxicity values, birds seem less sensitive than mammals” (SERA 2005). The acute toxicity is low, with oral LD_{50} values in experimental mammals ranging from approximately 500 to 3500 mg/kg. The effects observed in mammals after subchronic or chronic exposure to hexazinone are generally limited to decreases in body weight, increases in liver weight, and changes in blood enzyme levels associated with liver toxicity. Based on the available toxicity data and the estimated levels of exposure, there is very little indication that granular hexazinone is likely to cause adverse effects in terrestrial animal species (SERA 2005). An exception involves an exposure scenario in which birds consume hexazinone granules immediately after application. In this instance, reproductive effects and possibly overt signs of toxicity are possible. The plausibility of this risk for birds, however, is questionable. There is no data indicating that birds will consume any of the granular formulations that contain hexazinone. Thus, a lower limit on the exposure assessment is zero. If birds were to consume these granules preferentially, exposure levels could be much higher. In such a case, toxic effects, including mortality could occur. Without additional information, with which to improve the exposure assessment, the risk cannot be characterized further (SERA 1997a). The risk assessment (SERA 2005) anticipated potential adverse effects to mammals (based on the range of applications rates used by the Forest Service) that ate the impacted vegetation over a long period of time. "Adverse impacts to reproduction did not appear to be plausible and insufficient data whether weight loss would occur" over this period, though not a substantial number would be affected to detect any impacts from weight loss to the overall population (ibid).

The SERA risk assessment indicated that effects from hexazinone to birds and mammals would more likely be the result of effects to vegetation which would be a secondary effect due to reduction in food or prey base or potentially an increase in other vegetation and associated prey base (SERA 2005).

The Site-Specific Risk Assessment analysis conducted for the Freds Fire Reforestation Project showed that no exposure scenarios at any level (acute or chronic) exceed the NOAEL (USDA 2009).

Table 3-45. Summary of Hazard Quotients for Terrestrial Wildlife – Hexazinone

Summary of Risk Characterizations at Highest Application Rate (3 lbs/acre)						
Receptor	Scenario	Hazard Quotients			Toxicity Values (mg/L)	Toxicity Endpoint
		Central	Lower	Upper		
Acute/Accidental Exposures						
Direct Spray						
first-order absorption	Small mammal	1E-02	5E-03	2E-02	400	NOAEL
100% absorption	Small mammal	0.2	0.2	0.2	400	NOAEL
100% absorption	Honey Bee	0.4	0.4	0.4	1075	NOAEL
Contaminated Insects						
	Small Bird	8E-03	8E-03	0.02	550	NOAEL
Consumption of contaminated small mammal						
	Carnivorous bird	0.02	0.02	0.02	550	NOAEL
Chronic/Longer-term exposures						
Consumption of contaminated Fish						
chronic	Fish-eating bird	2E-04	6E-08	1E-03	150	NOAEL

Triclopyr

The effects of the herbicide triclopyr is summarized in a 2003 report (SERA 2003b), states that the risks of the herbicide at application rate equal to or greater than those used by the Forest Service are secondary to changes in vegetation and food supply for terrestrial animals. In addition, these changes will either have no effect or will be beneficial to birds and mammals.

An assessment of the potential toxic hazards associated with the exposures of wildlife mammalian species to triclopyr is based on the same studies on experimental mammals that are used in the human health risk assessment. Although triclopyr causes developmental effects only at doses that cause maternal toxicity, reproductive effects are obviously an endpoint of concern to both the human health and ecological risk assessments and the quantitative risk assessment for mammalian wildlife is based on the same data as used in the human health risk assessment. For birds, the most relevant data for this risk assessment are the standard dietary and bird reproduction studies required for registration as well as the acute oral LD_{50} studies. The acute oral LD_{50} values of triclopyr range from 849 mg/kg to 2055 mg/kg, similar to the range seen in experimental mammals. Several subchronic dietary studies have been conducted on triclopyr acid, triclopyr TEA, and triclopyr BEE. Based on these studies, the U.S. EPA/OPP (1998a, in SERA 2003b) has classified triclopyr BEE as practically non-toxic to birds.

The dose-response assessment for terrestrial mammals is based on the same toxicity values that form the basis of the RfDs used in the human health risk assessment: an acute NOAEL of 100 mg/kg/day, based on a gavage study in rats, and a chronic NOAEL of 5 mg/kg/day, based on a NOAEL in a multi-generation reproduction study in rats. Based on SERA (2003b), for this risk assessment the acute NOAEL for birds is taken as 388 mg/kg/day for triclopyr BEE, based on the 5-day dietary concentrations of 3884 ppm acid equivalents for triclopyr BEE. For chronic exposures, the NOAEL is taken as 10 mg/kg/day.

Exposure of triclopyr to terrestrial animals can occur via direct spraying or through the consumption of vegetation or prey species that have been exposed. The effects of exposure based on application rates used by the Forest Service is expected to be minimal based on results on experimental mammals and the lack of minimal bioconcentration in aquatic species (DFG 1994, SERA 1996b, Woodburn 1996, SERA 2003b). The application rate proposed under Alternative 1 takes potential risks from inadvertent exposure into consideration as well as taking measures to reduce spray drift. In addition stream buffers will be implemented to avoid any direct spray to water sources in the project area.

The risk characterization conducted in SERA (2003b) found that, for terrestrial mammals, the central estimates of hazard quotients do not exceed the level of concern for any exposure scenarios. At the upper range of exposures, the hazard quotients exceed the level of concern for large mammals and large birds consuming contaminated vegetation exclusively at the application site. At higher application rates, concern for exposure scenarios involving the consumption of contaminated vegetation is augmented substantially. At the maximum application rate of 10 lbs a.e./acre, the central estimate of the hazard quotient exceed the level of concern for several acute exposure scenarios: the direct spray of a small mammal assuming 100% absorption, a large mammal consuming contaminated vegetation, and a small bird consuming contaminated insects. The central estimates of the hazard quotients for the chronic consumption of vegetation is exceeded for a large mammal and a large bird and the upper range on the hazard quotients are also increased by a factor of 10: i.e., to 60 for a large mammal and 50 for a large bird.

Thus, the SERA 2003b risk assessment is consistent with the risk characterization given by U.S. EPA indicating that contaminated vegetation is primary concern in the use of triclopyr and that high application rates will exceed the level of concern for both birds and mammals in longer term exposure scenarios.

The Site-Specific Risk Assessment analysis conducted for the Freds Fire Reforestation Project at the highest application rate of triclopyr BEE proposed on this project (2.4 lb/acre) substantially reduces the potential for triclopyr-related effects from the maximum application rates (10 lbs/acre) analyzed in SERA 2003b. Furthermore, the limited use of triclopyr on the project (97 acres) reduces the potential for exposure. For species with potential for exposure on this project (Table 3-46), the three bat species and spotted owls, the site-specific analysis showed that none of the scenarios involving surrogate species, representing bats and owls, exceed a level of concern (HQ <1).

Table 3-46. Summary of Hazard Quotients for Terrestrial Wildlife – Triclopyr BEE

Summary of Risk Characterizations at Highest Application Rate (2.4 lbs/acre)						
Receptor	Scenario	Hazard Quotients			Toxicity Values (mg/L)	Toxicity Endpoint
		Central	Lower	Upper		
Acute/Accidental Exposures						
Direct Spray						
first-order absorption	Small mammal	0.4	4E-03	0.5	100	NOAEL
100% absorption	Small mammal	0.6	0.6	0.6	100	NOAEL
100% absorption	Honey Bee	0.4	0.4	0.4	1075	LD_{50}
Contaminated Insects						
	Small Bird	0.2	0.2	0.7	388	NOAEL
Consumption of contaminated small mammal						
	Carnivorous bird	0.02	0.02	0.02	388	NOAEL
Chronic/Longer-term exposures						
Consumption of contaminated Fish						
chronic	Fish-eating bird	6E-04	8E-05	1E-03	10	NOAEL

Chlorsulfuron

The Site-Specific Risk Assessment analysis conducted for the Freds Fire Reforestation Project showed that no exposure scenarios at any level exceed the NOAEL (Project File).

Additives

There has been little toxicity testing done on these additives, however additional effects may occur from exposure to ingredients used as dyes and surfactants in the herbicide mixtures. This project would use a MSO-based, a silicone/MSO blend, or a NPE-based surfactant, and Colorfast Purple or Hi-Light Blue dye. Risk quotients were developed for NPE-based surfactants, but not for the other surfactants or dyes, although some discussion of these substances is included in the project's Human Health risk assessment (Chapter 3- Human Health and Safety of Herbicide Use).

Colorfast Purple dye is intended to reduce the risk to humans by clearly marking sprayed vegetation, but would not necessarily be identified and avoided by animals. Basic Violet 3 dye is the colorant in Colorfast Purple. Most of the information about its toxicological effects is attributed to the chloride salt, commonly referred to as Gentian Violet. Gentian Violet is a suspected carcinogen, known mutagen, and skin and eye irritant (SERA 1997b). Gentian Violet has a moderate acute toxicity (LD_{50} of 96 mg/kg) (USDA 2007). Because the formulation of Colorfast Purple is proprietary, the concentration of the components is unknown, and the risk of potential exposure rates is difficult to determine (Ibid). However, colorants are expected to pose a minimal risk to wildlife at proposed application rates

Hi-Light Blue dye is not a registered pesticide and carries no signal word. It would carry a Caution signal word if one were to be assigned due to it being an irritant to the skin and eyes (USDA 2007). Hi-Light Blue is a water-soluble dye, is virtually non-toxic to humans and often used as a colorant for both toilet bowl cleaners and lakes and ponds. The effect on terrestrial and aquatic species is unknown, though the use of the dye has not created any known issues (USDA 2007).

A silicone/MSO blend surfactant (such as Syl-Tac®) is a blend of a vegetable oil and a silicon-based surfactant. Syl-Tac® has a Caution signal (practically non-toxic to slightly toxic). Syl-tac® is thought to be relatively low risk, but may be a skin or eye irritant. There is little information in the scientific literature based on effects of seed oils and silicone-based surfactants on mammals beyond some basic acute testing results. Standard mammalian acute toxicity results for Syl-Tac® were summarized as practically non-toxic at Oral LD_{50} (> 5 g/kg) and slightly toxic at Dermal LD_{50} (> 5g/kg) (USDA 2007).

Methylated seed oils are low acute oral and dermal toxicity. (USDA 2007). Most carry a Caution signal word for potentially slight irritant to eyes and skin.

The Human Health and Ecological Risk Assessment of Nonylphenol Polyethoxylate-based (NPE) Surfactants in Forest Service Herbicide Applications (USDA 2003a) summarizes the risk to terrestrial wildlife species. The active ingredient in NPE- based surfactants, nonylphenol polyethoxylate, has been linked to estrogenic effects in wildlife.

Based on the expected chronic exposure levels, there is little risk to terrestrial wildlife at any application rate (.25% to 2.5%, with the typical dilution of 1%) considered in that risk assessment.

In the Freds Fire Reforestation Site-Specific risk assessment (Table 3-47), based on the hazard quotients for the surrogate species of species of concern (bats, spotted owl), several of the scenarios represent a potential risk of effects to terrestrial wildlife. With typical application rates (2.0 lbs/acre), two of the acute scenarios result in hazard quotients that exceed unity (direct spray of a small mammal, assuming 100% absorption, and a small bird eating contaminated insects). Acute doses from 10 to 40 mg/kg/day may not represent a risk to mammals, in which case these typical scenarios may be of low risk, even though the hazard quotient exceeds unity. At the highest application rates, the small bird eating contaminated insect acute exposure scenario represents a high risk of effects (HQ=22). At exposures between 100 and 250 mg/kg/day, effects are uncertain in terms of seriousness, with inconsistent results in the various studies.

Both of these scenarios are unlikely. Given the assumptions, combined with typical animal behaviors, the actual exposure rate for a directly sprayed small mammal is likely somewhere in between the two scenarios (first order absorption and 100% absorption). The small bird eating contaminated insects scenario, used as a surrogate for a bat eating contaminated insects, may also be extremely conservative as it assumes that 100% of the insects consumed by the bird on the day of exposure (i.e, no dissipation is assumed) were directly sprayed.

The dose of herbicide received by a small mammal is estimated at 1 mg (Site-specific worksheets). Consumption by a owl, with an average weight of 3 lbs, would result in a dose to the owl of .67 mg/kg, well below the NOAEL of 10 mg/kg. indicating a low risk of effects.

Table 3-47. Summary of Hazard Quotients for Terrestrial Wildlife – NPE-based Surfactants

Summary of Risk Characterizations at Highest Application Rate (2 lbs/acre)						
Receptor	Scenario	Hazard Quotients			Toxicity Values (mg/L)	Toxicity Endpoint
		Central	Lower	Upper		
Acute/Accidental Exposures						
Direct Spray						
first-order absorption	Small mammal	8.1E-03	1.2E-03	0.1	10	NOAEL
100% absorption	Small mammal	**4.8**	**4.8**	**4.8**	10	NOAEL
Contaminated Insects						
	Small Bird	**7.5**	**7.5**	**22**	10	NOAEL
Contaminated fish						
	predatory bird	0.06	0.03	0.09	10	NOAEL
Chronic/Longer-term exposures						
Consumption of contaminated Fish						
chronic	Fish-eating bird	7.0E-05	0	2.1E-04	10	NOAEL

Sensitive Species

California Spotted Owl

Alternative 1 (Proposed Action)

Direct and Indirect Effects

Toxicological Effects: Herbicide use is expected to have no to minimal effects upon spotted owls as described under the Toxicological Effects Section, above.

Disturbance Effects: Limited Operating Periods are in place to prevent disturbance to nesting spotted owls, therefore, it is not anticipated that there will be disturbance-related effects.

Habitat Effects: Initially, planting trees and vegetation control will increase the number of seedlings, as well as enhance seedling survival and growth. The resultant plantations will, in the long term, aid in accelerating the area towards old forest characteristics, benefiting terrestrial threatened, endangered, and sensitive wildlife. Vegetation treatments with herbicides are also aimed at removing two invasive plants to prevent further spread and to enable native vegetation to return to the currently infested locations.

Within the Freds Fire area boundary, about 332 acres of green trees remain scattered across the landscape, based on green tree mapping in moderate and high intensity burn areas. These acres do not include individual trees scattered in the burn, which are primarily within the moderate intensity burn areas. Although these partially green stands provide some habitat for owls, their suitability as owl habitat will likely be reduced over time as fire-weakened trees continue to die and canopy cover is reduced further. Reforestation efforts will potentially start to provide foraging habitat for spotted owls, with 4M/4D conditions occurring potentially in <50 years, and 5M/5D conditions in 80 years.

Verner et al. 1992, found an average of 15 to 30 square feet of basal area in snags within owl foraging habitat. Planning for 2 or 3 snags per acre of larger diameter snags, that would remain standing in 30 to 50 years, would provide this level of snag basal area within newly developed foraging habitat. As snags fall, they will contribute to down logs, and as prey move out from the core areas of the PACs, spotted owls should see higher densities and improved foraging success in developing habitat. Because of the variety of size class of snags left in the RCAs (minimum of 2 per acre in the threat zone), many of the snags will have fallen within 20 years and would have already decomposed to levels below what is considered optimal for spotted owl by the time foraging habitat develops. This would be offset, however, by the snag retention clumps which provide some of the larger diameter snags (CWHR 4 and 5). There are approximately 162 acres within three snag patches in the project area. These areas are not planned for planting or vegetation control and will take longer to develop into denser canopied stands, even if natural regeneration occurs within these sites. Even if no natural regeneration occurs, these gaps still provide habitat diversity for prey species adjacent to developing planted stands.

Cumulative Effects

An analysis of cumulative effects to California spotted owls will consider the impacts of this alternative when combined with past, present, and foreseeable future actions and events that have affected or may affect the quantity or quality of spotted owl habitat within the analysis area. The cumulative effects analysis area has been established as a 27,000 acre area that encompasses both NFS and private lands within 1.5 miles of the project area (fire area) boundary. The geographic scope of the cumulative effects analysis was selected considering the home range of the spotted owl (4,500 acres) and multiplied by the number of owl PACs that fell within the 1.5 miles of the fire boundary. The PACs and HCRAs of a number of neighboring spotted owls (an additional 4 PACs) occur within this 1.5 mile distance, allowing an evaluation of the project's cumulative effects upon nesting, foraging and dispersal capabilities of spotted owls (6 PACs) within and adjacent to the project area.

The magnitude of changes from projects, which have effects for the six spotted owl PACs within the cumulative effects analysis area is derived from past disturbance information. This information is based upon the Forest's existing vegetation data (1997) which, through acres in plantations, shows regeneration harvest that has occurred on National Forest System and private lands since the mid-1960's; the fire history layer for the ENF, the FACTS database which shows fuels treatments that have occurred on National Forest lands since 1990 (few treatments occurred prior to 1995); and Cumulative Watershed Effects Reports which provide additional effects analysis information for the Freds Fire and surrounding area. Habitat in plantations, planted in post 1975, as well as high severity wildfire acres that have occurred within the past few decades, is assumed to be unsuitable. Commercial thinning treatments, and low to moderate severity wildfires, are assumed to have degraded spotted owl habitat, but not to have been rendered habitat unsuitable for owl foraging.

The project area overlaps a portion of the Freds Fire Restoration Project (which overlapped the Freds Fire boundary) in which fire salvage was completed on approximately 2,936 acres.

Within the 1.5 mile distance from the Freds Fire boundary, have been several wildfires that have removed suitable spotted owl habitat and created areas of fragmentation between spotted owl PACs. Specific projects for this cumulative analysis includes past large wildfires, including the Freds, Cleveland Wrights Pilliken, and the Icehouse Fire. Within the Freds, Cleveland, Wrights and Pilliken Fire areas, vegetation changes prior to the fires are not relevant to the cumulative effects analysis as the fires altered vegetative structure to the date they occurred. Outside of these fire areas timber harvest, fuels treatments, and hazard tree removal projects have altered the quantity and quality of spotted owl habitat. These include the planting in the Freds Fire area, the

Jane Doe and Roadrunner Fuels Reduction thinning and mastication projects, and fire salvage in the Freds Fire Restoration project. Other projects include the Algorythym Roadside Hazard Project and private fire salvage. The Algorythym Project overlaps that of salvage acres so the acres won't be duplicated for this analysis.

Tree planting may accelerate the development of future suitable spotted owl habitat faster than natural regeneration in the Freds Fire area. Maintenance of existing plantations from past fires outside the Freds Fire will aid in achieving mature forest faster than if left untreated, providing future habitat for spotted owls, as well as re-establishing connectivity between forested areas, including plantations treated in the Middle Creek area under the planned Silver Saddle Sale Forest Health Project.

Another aspect that could impact the development of owl habitat in the Freds Fire is a future wildfire. The project areas lies in both defense and threat zone allocations due to the urban-wildland interface created by Highway 50, summer home tracts, local businesses, other facilities, and high public use. The American River Canyon has had large wildfires for the past few decades. This combined with private land has fragmented suitable habitat for spotted owls across the landscape, particularly for the two remaining PACs in the Freds Fire area. The Freds Fire adds to this fragmentation, as well as increasing the nearest neighbor distance between remaining PACs.

The threat of another large wildfire occurring along Highway 50 in the South Fork American River corridor within 10 years is high (Chapter 3 - Fire and Fuels). The Highway 50 corridor has had four large wildfires within the past 31 years (Wrights, Cleveland, St. Pauli and Freds). Other large fires on the Eldorado within the past five years include the Star, Plum Complex, and Power Fire. The potential for a wildfire start is high due to proximity to the large number of travelers along Highway 50, a PG and E distribution line that runs through the canyon, residential development, summer home tracts, recreational use, and lightning.

Predicted fire behavior modeling of timber stands and fuel types that are representative of current conditions, indicates that high intensity fire with rapid rates of spread would be likely under moderate weather conditions (Chapter 3 – Fire and Fuels). Regardless of the type of fuel loading, the area has a high risk of wildfire repeating across the landscape, risking the development of late seral habitat features and future habitat for mature forest species. Repeat wildfire through the area, should it happen, would maintain the area in "early seral" conditions favored by sensitive species or their prey that utilize that type of habitat. The effects of this alternative compared to the No Action Alternative with regards to fire risk is that, with the proposed treatments, a fuel complex with rapid rates of spread and little resistance to control it is less likely develop within 25 years. This alternative would also create conditions more favorable to enable deployment of suppression resources that would be more efficient in reducing damage caused by wildfire (Chapter 3 – Fire and Fuels).

The majority of the suitable spotted owl habitat in the analysis area occurs within the current PAC designation for PAC ED-103 and ED-139. The indirect effects of Alternative 1 do not contribute to past or future reductions in the amount of current suitable spotted owl habitat, but may increase the quality of future habitat by enhancing site conditions to speed the development of planted and naturally regenerated seedlings across the landscape. As no suitable habitat is affected, no expected increase in negative cumulative effects from this alternative is expected. In the long run, the project may improve habitat capability for this species, when considered with other present and foreseeable projects. This is based on remaining suitable habitat being retained, and that the alternative is expected to help provide for future habitat connectivity which will aid in the reduction of fragmentation between PACs and HRCAs.

Alternative Conclusion

Alternative 1 may affect individuals but will not lead to a trend towards federal listing or a loss of viability for the California spotted owl. This conclusion is based on:

Mitigations in the form of Limited Operating Periods will aid in preventing disturbance to nesting spotted owls.

No to minimal risk to owls from herbicide applications.

No reduction of existing suitable spotted owl habitat.

Planting of seedlings and vegetation control will accelerate tree growth within the area to aid in restoring late seral habitat and connectivity between PACs; thereby providing a beneficial effect to spotted owls.

Alternative 2 (No Action)

Direct, Indirect and Cumulative Effects:

Toxicological Effects: As no herbicide application is planned under this alternative, there will be no toxic effects to spotted owls from herbicides.

Disturbance Effects: As no activities are proposed, there will be no disturbance-related effects to spotted owls.

Habitat Effects: Without managed reforestation, habitat on forest lands would progress through successional changes, taking up to 150 years in already planted stands (Chapter 3 – Vegetation Management) to develop into conifer forest SMC 4M/4D/5M or better and over 150 years to develop into 5D stands. In unplanted areas, it is unlikely for stands to reach 40% or greater canopy closure within 150 years, resulting in potential lack of foraging habitat preferred by spotted owls.

Salvage of dead trees has been completed on private and public lands. Reforestation has started on both private and public lands and private landowners have utilized herbicides to control competing vegetation. Montane chaparral has been reduced on private land through the use of herbicides. Tree dominated habitat will recover quickly through growth of planted and natural regenerating conifer seedlings, and typically reach CWHR size class 3 (6-12 inches DBH) within 20 years on private lands. Adjacent private lands will exhibit a more managed even-aged SMC or Ponderosa Pine (PPN) conifer habitat for the next 50 years. Habitat within the Freds Fire area on NFS land will be a mosaic of hardwoods, brush, grass and conifers in varying age sizes and classes. The size and location of these habitat components will be dependent on the intensity of the fire in a particular area and the survival of individual or small clumps of large trees, as well as survival of seedlings that have been planted in the area.

By far, the greatest impact to the spotted owl and its habitat was the Freds Fire itself. Areas of high intensity burn provide no suitable habitat for the spotted owl. Early-seral conditions would persist in stands with greater than 75% mortality for at least 50 years under this alternative. Assuming natural succession, it is estimated that it would take at least 150 years to develop habitat conditions suitable for spotted owls (i.e. SMC 4M or better) and up to 250 years to develop "old-forest" conditions (SMC 6) that spotted owls most prefer. Most of the snags created by the fire and that remain post-fire salvage, (even the largest) will have fallen by the time mature forest conifer habitat develops (Morrison and Raphael 1993). Based on the decay rate used for the SNFP most of these fallen snags will be in advanced stages of decay in 100 years. Few of these may persist as down logs, which are an important element for quality spotted owl habitat (Verner et al. 1992).

Prey species preferred by spotted owl (woodrats and flying squirrels) will likely avoid the burn area (Smith 2000) until habitat conditions become favorable to them. As Montane chaparral (MCP) stands mature, woodrats may recolonize this habitat at elevations below 5,000 feet (Mayer and Laudenslayer 1988). Flying squirrels will likely be absent in high intensity burn areas until mature conifer habitat or large diameter oak develops.

The small patches of currently suitable habitat within the fire area would persist over the short-term, which may provide dispersal habitat from areas unaffected by the fire. These areas will provide legacy elements of late seral habitat (large trees, snags, logs) within stands that have been planted or naturally regenerated, on both private and public lands. The suitability of these stands will diminish somewhat in the short term, as green trees weakened by the fire or other environmental conditions continue to die, thereby reducing canopy closure.

Habitat will likely be present sooner with reforestation and some form of treatment of competing brush on private lands. Habitat that develops there could be utilized by owls, which would be important for dispersal between unburned areas north and south of the fire. In addition, existing live trees will provide small remnant patches of mature forest structure and add to snag recruitment over the long term on NFS land. Oak that was killed by the fire will continue to stump sprout and develop a canopy, possibly within ten years, depending on site conditions. Large oaks that survived the fire will continue to provide canopy cover, primarily in the low intensity burn areas. On Sierra Pacific Industries lands treated after the Freds Fire, stands that develop will likely be even-aged and would not provide the multi-canopy structure that spotted owls prefer, though it could still provide foraging habitat or security and thermal cover.

Existing yellow starthistle infestation areas would continue to expand into open or disturbed areas, including areas that are currently being treated on private land and adjacent NFS land within the historic Cleveland Fire area, reducing habitat value for wildlife.

Alternative Conclusion and Summary

This alternative will not affect the suitability of existing habitat within the project area and will have no indirect, direct or cumulative effect on spotted owls, and therefore, would not lead to a trend toward federal listing or loss of viability.

Alternative 3

Direct, indirect and cumulative effects:

Toxicological Effects: No toxic effects upon spotted owls are expected as no herbicides are proposed for use.

Disturbance Effects Limited Operating Periods are in place to prevent disturbance to nesting spotted owls, therefore, it is not anticipated that there will be disturbance-related effects.

Habitat Effects: Effects to spotted owl habitat would be similar to that described under Alternative 1 based on silvicultural modeling with the exception of 800 acres that would not be planted or have vegetation treatment. These 800 acres would develop as described under the No Action Alternative and would delay spotted owl habitat from developing, where site conditions allow, within those acres as compared to managed acres under Alternative 1. Under this alternative development of spotted owl habitat within planted acres may take 110 years to reach 4M/4D, 115 years to reach 5M and >150 years to reach 5D, based on silvicultural modeling. Unplanted acres are unlikely to achieve >40% crown closure within 150 years.

Cumulative effects would be similar to that described for Alternative 1 with the exception of reduced acreage under tree planting (800 acres) and no herbicide applications. Effects from future fire risk would be similar to the No Action Alternative because hand grubbing in a radius around planted trees will not diminish the brush component to the extent that it would alter the fuel loading to change predicted fuel modeling (Chapter 3 - Fire and Fuels).

Alternative Conclusion and Summary

Alternative 3 may affect individuals but will not lead to a trend towards federal listing or a loss of viability for the California spotted owl. This conclusion is based on:

Mitigations in the form of Limited Operating Periods will aid in preventing disturbance to nesting spotted owls.

No reduction of existing suitable spotted owl habitat.

Planting of seedlings and vegetation control will accelerate tree growth within the area to aid in restoring late seral habitat and connectivity between PACs; thereby providing a beneficial effect to spotted owls.

Pallid, Townsend's Big-Eared and Western Red Bat

Alternative 1 (Proposed Action)

Direct and Indirect Effects

Toxicological Effects: Herbicide use is expected to have no to minimal effects upon bat species as described under the Toxicological Effects Section for all species in regards to mammals and also invertebrates (prey species in regards to bioaccumulation).

Disturbance Effects: In the absence of surveys, it is assumed that individual roost sites may occur in large hardwoods, snags, and rock outcrops scattered throughout the project area. It is likely that some of these habitat features may hold either or all: hibernaculum, maternity or basic roost sites for bat species. There is minimal risk of breeding disturbance as roost features will not be directly affected by project activities. It is possible that if a roost tree exists within or immediately adjacent to a treatment unit, human activity at the base of the tree may cause some disturbance, however, as individual roost trees are unknown, it is impossible to assess the likelihood of this occurring. As oaks would not be intentionally sprayed, including seedlings, sprouts and larger trees, it is not expected that there would be contact with large trees (no planting within 20 feet). The potential for disturbance would be limited by human presence outside that 20 foot zone. BMPs that protect RCAs, as well as no removal of riparian deciduous trees will aid in protecting western red bat roost habitat. These avoidance measures, as well as the short duration of activities and timing across the project area, further reduces the risk of disturbance to bat populations.

Habitat Effects: Effects to habitat (trees) would be similar to that described for spotted owls in regards to both late and early seral habitat. In the short-term, existing roosting habitat will not be removed within the project area. Planting of seedlings and vegetation control will promote faster development of trees, both oak and conifer, to provide roosting habitat for bat species in the long term. In Montane Hardwood and Montane Hardwood-Conifer stands that burned in the fire, oaks will regenerate through stump sprouting but will likely not mature for at least 80 years. Project treatments under this alternative will shorten that timeframe, as well as enable oaks to increase across the landscape by the reduction in competition with brush.

A study of post-fire herbicide spraying by DiTomaso et al (1997) indicated very low shrub cover (1, 7 and 11 percent cover) in three sprayed areas after 2, 8 and 12 years following fire, respectively, compared to 75, 44, and 103 percent cover in the same respective areas not treated with herbicides. It is unclear whether similar results would occur on the treatment units since there seems to be a high degree of variability in the efficiency of herbicide treatments. Assuming project objectives are met, however, shrub cover would be reduced from between 40 to 100 percent, and in some areas, at least below 20 percent for a minimum of 5 years. The DiTomaso study involved hexazinone. Under this project about 100 acres would be treated with hexazinone; therefore; it is anticipated that the results would not be as severe as those in the DiTomaso study.

Herbaceous vegetation and some amount of shrub cover or re-growth would be likely to remain on the treated units, but bat prey habitat provided by these units would decline over five to ten years. Proposed shrub removal through mastication or herbicides has the potential to displace invertebrate prey species both from disturbance and alteration of prey habitat structure (forage and host plants). Leaving pockets of untreated areas will reduce this effect. Prey availability may be less than the No Action Alternative for invertebrate species that utilize brush or grasses; however, additional openings will increase oak and conifers and invertebrates associated with this habitat type for the pallid bat.

Acres within units that overlap RCAs are variable due to noncontiguous deciduous tree component, however, RCA objectives will aid in protecting roosting habitat for the red bat and foraging habitat for all three species.

Cumulative Effects

Given the changes in forest vegetation that have been described within the Sierra Nevada over the last 100 years, it is likely that there are less mature hardwoods, and denser conifer vegetative conditions less than eight feet high, within mid-elevation stands than there were historically. This would suggest a historic reduction in foraging habitat availability and quality. It is unclear what the cumulative effect of past actions may have been on sensitive bat species in the Freds Project analysis area. Timber harvest may have removed existing and future snags that could have been utilized by bats for roosting, and may have also opened the understory up for foraging opportunities. Other cumulative effects in regards to tree or snag removal and/or plantation treatments would have similar effects as described under the spotted owl under Alternative 1. The reduction in risk of future wildfires, promotion of future hardwood habitat, and maintaining open understory over the long term meets several of the conservation measures suggested for bats in the SNFPA (USDA 2004b).

Alternative Conclusion

The Proposed Action Alternative may affect individuals, but is not likely to lead to a trend towards federal listing or loss of viability for the pallid bat, Townsend's big-eared bat or the western red bat. This determination is based upon the following factors:

The Proposed Action Alternative maintains habitat characteristics believed to be important for the pallid, Townsend's big-eared and western red bat. Prescriptions are designed to retain and improve the current and future number of large diameter trees, snags, and down logs, and protect riparian corridors.

Treatment of brush through herbicides as well as mastication will alter invertebrate prey habitat (host plants), primarily that of lepidopterans, a favored prey species of the Townsend's big-eared bat.

An increase of hardwoods within stands will improve habitat, primarily pallid bat, in regards to black oak improvement, as the species has been detected utilizing the Silverfork of the American River corridor.

Alternative Two (No Action)

Direct and Indirect Effect:

Toxicological Effects: No toxic effects upon pallid bat, Townsend's big-eared bat or western red bat are expected as no herbicides are proposed for use.

Disturbance Effects: As no activities are proposed under this alternative, there will be no disturbance-related effects to pallid bat, Townsend's big-eared bat or western red bat.

Habitat Effects: The Freds Fire created open habitats and large snags (162 acres in snag patches and additional snags scattered over the project area), including oak, which are favored by bat species as habitat. Large live trees that succumbed to the fire after fire salvage provide suitable roosting habitat for bats, currently in the form of snags and in the future as down logs. Remaining green trees serve as potential recruitment snags. These categories of trees aid in replacing or contributing to the existing standing snag and down log component, across the landscape as part of natural snag cycling. Conifer snag species include ponderosa pine, sugar pine, incense cedar, Douglas-fir, white fir, Jeffrey pine and red fir. Insects invading dead trees may provide some prey for these bat species; however, pallid bats favor ground-dwelling insects. As montane chaparral matures and forms a closed canopy, foraging habitat quality will be reduced for pallid bat as openings are filled in, reducing invertebrate prey species associated with open ground. Invertebrates associated with shrub species will still provide a prey base for all three bat species.

Oaks burned by the fire have stump sprouted in these areas, but may still take up to 80 years provide the structure to support habitat for roosting bats in hollow limbs, trunks or tops as well as cracks within the bark.

Habitat quality on both private and public lands in the Freds Fire is considered low in regards to roosting for bats because of the low snag levels retained. However, bats roosting on adjacent forest lands may forage on the more open Freds Fire project until the oak canopy begins to close in the short term (15 to 20 years) and when conifers reach a size to develop a closed canopy in the long term (refer to spotted owl discussion).

Natural regeneration would reduce habitat suitability in the long term for bats, as they tend to prefer more open habitat types for foraging. However, the growth of large conifers and oaks will provide future recruitment of snags in the long term. If a high intensity wildfire returned and re-burned the area, most snags providing roost sites for this species would be lost before new snags could be recruited from mature conifer and oak stands.

Additional effects under this alternative would be similar to that described for the spotted owl.

Cumulative Effects

As there are no indirect or direct effects, there are also no cumulative effects associated with this project under the No Action Alternative. The No Action Alternative would not directly affect nor add to any adverse cumulative effects for the pallid, Townsend's big eared or western red bat or their existing habitats.

Alternative Conclusion

No activities are occurring under this alternative. The No Action Alternative will not affect the suitability of existing habitat within the project area and will have no indirect, direct or cumulative effect on pallid bat, Townsend's big-eared bat or western red bat, and therefore, would not lead to a trend toward federal listing or loss of viability.

Alternative 3

Direct, Indirect and Cumulative Effect:

Toxicological Effects: No toxic effects upon pallid bat, Townsend's big-eared bat or western red bat are expected as no herbicides are proposed for use.

Disturbance Effects: In the absence of surveys, it is assumed that individual roost sites may occur in large hardwoods, snags, and rock outcrops scattered throughout the project area. It is likely that some of these habitat features may hold either or all: hibernaculum, maternity or basic roost sites for bat species. There is minimal risk of breeding disturbance as roost features will not be directly affected by project activities. It is possible that if a roost tree exists within or immediately adjacent to a treatment unit, human activity at the base of the tree may cause some disturbance, however, as individual roost trees are unknown, it is impossible to assess the likelihood of this occurring. As oaks would not be intentionally removed, including seedlings, sprouts and larger trees, it is not expected that there would be contact with large trees (no planting within 20 feet). The potential for disturbance would be limited by human presence outside that 20 foot zone. BMPs that protect RCAs, as well as no removal of riparian deciduous trees will aid in protecting western red bat roost habitat. These avoidance measures as well as the short duration of activities and timing across the project area, further reduces the risk of disturbance to bat populations.

Habitat Effects: Effects to bat habitat would be similar to that described under Alternative 1 with the exception of 800 acres that would not be planted or have vegetation treatment, which would develop as described under the No Action Alternative. Alternative 3 would retain foraging habitat longer (invertebrate host plants) within those acres as compared to Alternative 1. Cumulative effects under Alternative 3 would be similar to that described for Alternative 1 except that vegetation management will be occurring within a 5 foot radius around trees, retaining shrub component and prey habitat, outside these circles, tree planting would be reduced, and there would be no herbicide applications.

Alternative Conclusion and Summary

This alternative may affect individuals, but is not likely to lead to a trend towards federal listing or loss of viability for the pallid bat, Townsend's big-eared bat or the western red bat. This conclusion is based upon the following factors:

Alternative 3 maintains habitat characteristics believed to be important for the pallid, Townsend's big-eared and western red bat.

Prescriptions are designed to retain and improve the current and future number of large diameter trees, snags, and down logs, and protect riparian corridors

Treatment of brush through hand grubbing and mastication will alter invertebrate prey habitat (host plants), primarily that of lepidopterans, a favored prey species of the Townsend's big-eared bat.

An increase of hardwoods within stands will improve habitat, primarily pallid bat, in regards to black oak improvement, as the species has been detected utilizing the Silver Fork of the American River corridor.

Terrestrial Management Indicator Species

Affected Environment

Management Indicator Species (MIS) for the Eldorado NF are identified in the 2007 Sierra Nevada Forests Management Indicator Species Amendment (USDA 2007b). The habitats and ecosystem components and associated MIS analyzed for the project were selected from this list of MIS, as indicated in Table 3-48 (species analyzed for this project are shaded). In addition to identifying the habitat or ecosystem components , the CWHR type(s) defining each habitat/ecosystem component, and the associated MIS, Table 3-48 discloses whether or not the habitat of the MIS is potentially affected by the Fred's Fire Reforestation Project. The MIS in Category 3 (fox sparrow, mountain quail), whose habitat would be either directly or indirectly affected, are evaluated for direct, indirect, and cumulative effects.

Effects of Proposed Project on the Habitat for the Selected Project-Level MIS

The analysis of the effects of the Freds Project on the MIS habitat for the selected project-level MIS is conducted at the project scale. Habitat has been identified utilizing CWHR classification (Mayer and Laudenslayer 1988) that was obtained utilizing the 1997 Forest Vegetation Inventory. Detailed information on the MIS is documented in the SNF Bioregional MIS Report (USDA Forest Service 2008b), which is hereby incorporated by reference. Cumulative effects at the bioregional scale are tracked via the SNF MIS Bioregional monitoring, and detailed in the SNF Bioregional MIS Report (USDA Forest Service 2008b).

Shrubland- West-Slope Chaparral (Fox Sparrow)

Habitat/Species Relationship: The fox sparrow was selected as the MIS for shrubland (chaparral) habitat on the west-slope of the Sierra Nevada, comprised of montane chaparral (MCP), mixed chaparral (MCH), and chamise-redshank chaparral (CRC) as defined by the California Wildlife Habitat Relationships System (CDFG 2005). Recent empirical data indicate that, in the Sierra Nevada, the fox sparrow is dependent on open shrub-dominated habitats for breeding (Burnett and Humple 2003, Burnett et al. 2005, Sierra Nevada Research Center 2007).

Project-level Effects Analysis - Shrubland (West-Slope Chaparral) Habitat

Habitat Factors for the Analysis: (1) Acres of shrubland (chaparral) habitat [CWHR montane chaparral (MCP), mixed chaparral (MCH), and chamise-redshank chaparral (CRC)]. (2) Acres with changes in shrub ground cover classes (Sparse=10-24%; Open=25-39%; Moderate=40-59%; Dense=60-100%. (3) Acres with changes in CWHR shrub size class Seedling Shrub (seedlings or sprouts (<3 years); Young shrub (no crown decadence); Mature Shrub (crown decadence 1-25%); Decadent Shrub (>25%).

Current Condition of the Habitat Factors in the Project: There are 714 acres comprised of shrubland habitat within the project treatment areas. Shrub age varies across similar acres from mature shrubs to young plants in created gaps, dependent on the intensity of burning the areas received during the Freds Fire.

Table 3-48. Selection of Terrestrial MIS for Project-Level Habitat Analysis for the Fred's Fire Reforestation Project

Habitat or Ecosystem Component	CWHR Type(s) Defining the Habitat or Ecosystem Component[1]	Sierra Nevada Forests Management Indicator Species Common and *Scientific Name*	Category for Project Analysis[2]
Shrubland (west-sloped chaparral types)	Montane chaparral (MCP), mixed chaparral (MCH), chamise-redshank chaparral (CRC)	Fox Sparrow *Passerella iliaca*	3
Sagebrush	Sagebrush (SGB)	Greater Sage-Grouse *Centrocercus urophasianus*	1
Oak-associated Hardwood and Hardwood/Conifer	Montane Hardwood (MHW), Montane Hardwood-Conifer (MHC)	Mule Deer *Odocoileus hemionus*	2
Riparian	Montane Riparian (MRI), Valley Foothill Riparian (VRI)	Yellow warbler *Dendroica petechia*	2
Early Seral Coniferous Forest	Ponderosa Pine (PPN), Sierran Mixed Conifer (SMC), White Fir (WFR), Red Fir (RFR), Eastside Pine (EPN), tree sizes 1, 2, and 3, all canopy closures.	Mountain Quail *Oreortyx pictus*	3
Mid Seral Coniferous Forest	Ponderosa Pine (PPN), Sierran Mixed Conifer (SMC), White Fir (WFR), Red Fir (RFR), Eastside Pine (EPN), tree size 4, all canopy closures.	Mountain Quail *Oreortyx pictus*	3
Late Seral Open Canopy Coniferous Forest	Ponderosa Pine (PPN), Sierran Mixed Conifer (SMC), White Fir (WFR), Red Fir (RFR), Eastside Pine (EPN), tree size 5, canopy closures S and P.	Sooty (blue) grouse *Dendragapus obscurus*	2
Late Seral Closed Canopy Coniferous Forest	Ponderosa Pine (PPN), Sierran Mixed Conifer (SMC), White Fir (WFR), Red Fir (RFR), Eastside Pine (EPN), tree size 5 (canopy closures M and D) and tree size 6.	California Spotted Owl *Strix occidentalis occidentalis* American Marten *Martes americana* Northern Flying Squirrel *Glaucomys sabrinus*	2 2 2
Snags in Green Forest	Medium and Large Snags in Green Forest	Hairy Woodpecker *Picoides villosus*	2
Snags in Burned Forest	Medium and Large Snags in Burned Forest (Stand Replacing Fire)	Black-Backed Woodpecker *Picoides arcticus*	2

[1] CWHR size classes and canopy (refer to Table 3-38). In addition, **canopy closure**: S=10-20% canopy closure); **Tree size classes**: 1 (Seedling <1" dbh); 2 (Sapling 1"-5.9" dbh).

[2] **Category 1:** MIS whose habitat is not in or adjacent to the project area and would not be affected by the project.
Category 2: MIS whose habitat is in or adjacent to project area, but would not be either directly or indirectly affected by the project.
Category 3: MIS whose habitat would be either directly or indirectly affected by the project.

Environmental Consequences

Alternative 1 (Proposed Action)

Direct and Indirect Effects to Habitat: There are approximately 714 acres have scattered acreage of CWHR montane chaparral in varying ages and size classes occurring within treatment areas. The remaining habitat falls within conifer, hardwood or riparian designations, which have scattered components of shrubs in the understory where conditions allow.

Change in Acres of Shrubland Habitat, Ground Cover Classes and CWHR Size Classes: Fox sparrows prefer burned-over forest land at a stage of recovery with heavy growth of brush (Austin 1968). At post-fire sites in the Sierra Nevada fox sparrow densities change as brushy fields of chaparral mature (Bock and Kynch 1970, Bock et al. 1978). Approximately 10 years after a fire, montane chaparral reached a density sufficient to support the species. After the Freds Fire, shrubs in the area expanded and are currently at least 4 years of age in areas that received high intensity burning. In areas of light or moderate burning, shrubs may have survived intact, re-sprouted, or expanded into newly created openings with the reduction in overstory tree canopy. Based upon this information, Alternative 1 will reduce habitat for fox sparrows for approximately 10 years (until shrubs provide dense mature fields) following treatments, in areas with shrub removal. This will come from herbicide treatment on roughly 714 acres, though portions of these acres won't be treated due to buffers, radial treatments and avoidance areas. Shrubs across an additional 388 acres will be affected through mastication. It is expected that some untreated patches of shrubs will remain in the project treatment units as well as in adjacent areas within in the original Freds Fire burn boundary that aren't within treatment units. Based on this it is anticipated that the area and will continue to support fox sparrows over this 10 year period.

Cumulative Effects to Habitat in the Analysis Area: Approximately up to 714 acres of shrubland habitat would be treated under Alternative 1. The reduction of shrub ground cover and creation of early seral size classes from the Freds project will reduce habitat quality for fox sparrows for up to 10 years.

The project area overlaps a portion of the Freds Fire Restoration Project (which overlapped the Freds Fire boundary) in which fire salvage was completed on approximately 2,936 acres. This opened up areas for further shrub establishment. This alternative would manage approximately 3,320 acres within the Freds Fire boundary as plantations (conifer dominated), reducing the potential for increasing or maintaining fox sparrow shrubland habitat in these areas.

Another aspect that could impact the development of fox sparrow habitat in the Freds Fire is the possibility of future wildfire. The American River Canyon has had large wildfires for the past few decades and the threat of another large wildfire occurring along Highway 50 in the South Fork American River corridor within 10 years is high (Chapter 3-Fire and Fuels). Predicted fire behavior modeling of timber stands and fuel types that are representative of current conditions, indicates that high intensity fire with rapid rates of spread would be likely under moderate weather conditions. Regardless of the type of fuel loading, the area has a high risk of wildfire repeating across the landscape, risking the development of late seral shrub habitat if future fire were to remove shrubs retained after the Freds Fire (and associated projects) occurred. However, fire occurring within the area again would maintain the area in an early seral condition, benefiting fox sparrow in other areas where trees are removed and shrub habitat is not only enhanced or increased but retained.

Cumulative Effects Conclusion: There will be a reduction in shrub habitat types as 714 acres will be converted to early seral conifer vegetation, altering the existing trend in the amount of habitat type in the project units. Though the acreage, quality of size class, and cover class shrub habitat will be altered, the acres of shrubland habitat in untreated areas as well as pockets within treated areas, in the project boundary will be retained and provide both nesting and dispersal corridors for the fox sparrow.

Alternative 2 (No Action)

Direct and Indirect Effects to Habitat: This alternative will not result in any direct or indirect effects to shrubland habitats.

Cumulative Effects to Habitat in the Analysis Area: As there are no direct or indirect changes in existing circumstances, there will be no cumulative effects associated with this project under this alternative in regards to change in acres of: shrubland habitat; shrub ground cover classes; or CWHR shrub size class.

Cumulative Effects Conclusion: There will be no changes in habitat from current conditions under the No Action Alternative.

Alternative 3

Direct, Indirect and Cumulative Effects to Habitat: Effects on fox sparrow habitat under Alternative 3 would be the same as described in Alternative 1 with the exception of 800 additional acres that won't be treated, including 162 acres of snag patches which are now brush dominated. These additional acres would continue to develop into mature shrubs where site conditions allow, increasing the suitability of habitat for fox sparrow within six or less years (dependent on current age of the shrub component in an area).

Cumulative Effects Conclusion: Shrub habitat types over 552 acres will be converted to early seral conifer vegetation in terms of acres of habitat and therefore will alter the existing trend in the amount of habitat type in the project units. Though the acreage, quality of size class, and cover class shrub habitat will be altered, the acres of shrubland habitat in untreated areas as well as pockets within treated areas, in the project boundary will be retained and provide both nesting and dispersal corridors for the fox sparrow.

Summary of Fox Sparrow Status and Trend at the Bioregional Scale

The ENF LRMP (as amended by the SNF MIS Amendment) requires bioregional-scale habitat and distribution population monitoring for the fox sparrow; hence, the shrubland effects analysis for the Freds Fire Project must be informed by both habitat and distribution population monitoring data. The sections below summarize the habitat and distribution population status and trend data for the fox sparrow from the Sierra Nevada Forest Bioregional MIS Report (USDA 2008b).

Habitat Status and Trend: There are currently 922,000 acres of west-slope chaparral shrubland habitat on NFS lands in the Sierra Nevada. Within the last decade the trend is stable.

Population Status and Trend. The fox sparrow has been monitored in the Sierra Nevada at various sample locations by avian point counts and breeding bird survey protocols. These data indicate that fox sparrows continue to be present at these sample sites, and current data at the rangewide, California, and Sierra Nevada scales indicate that, although there may be localized declines in the population trend, the distribution of fox sparrow populations in the Sierra Nevada is stable.

Relationship of Project-Level Habitat Impacts to Bioregional-Scale Fox Sparrow Trend

Though the quality of size class and cover class shrub habitat will be altered, the change in acres of shrubland habitat on the 714 acres of shrubland habitat occurring in the Freds Project area will not alter the existing trend in the amount of habitat acres, nor will it lead to a change in the distribution of fox sparrows across the Sierra Nevada bioregion.

Early and Mid Seral Coniferous Forest Habitat (Mountain Quail)

Habitat/Species Relationship: The mountain quail was selected for early and mid seral coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, red fir, and eastside pine) habitat in the Sierra Nevada. Early seral coniferous forest habitat is comprised of primarily seedlings (<1" dbh), saplings (1"-5.9"), and pole-sized trees (6"-10.9" dbh). Mid seral coniferous forest habitat is comprised primarily of small-sized trees (11"-23.9" dbh). The mountain quail is found particularly on steep slopes, in open, brushy stands of conifer and deciduous forest and woodland, and chaparral; it may gather at water sources in the summer, and broods are seldom found more than one half mile from water (CDFG 2005).

Project-level Effects Analysis - Early and Mid Seral Coniferous Forest Habitat

Habitat Factors for the Analysis: (1) Acres of early (CWHR tree sizes 1, 2, and 3) and mid seral (CWHR tree size 4) coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, red fir, and eastside pine) habitat [CWHR ponderosa pine (PPN), Sierran mixed conifer (SMC), white fir (WFR), red fir (RFR), eastside pine (EPN), tree sizes 1, 2, 3, and 4, all canopy closures]. (2) Acres with changes in CWHR tree size class. (3) Acres with changes in tree canopy closure. (4) Acres with changes in understory shrub canopy closure.

Current Condition of the Habitat Factors(s) in the Project Area: There are 3,320 acres of early seral to mid seral coniferous forest in the project area. Shrubs of varying ages and size classes are scatted over the 3,816 acres within the treatment unit boundaries.

Alternative 1 (Proposed Action)

Direct and Indirect Effects to Habitat: The effects of the Freds Fire increased habitat for the mountain quail by removing late seral size trees and creating gaps for natural regeneration of conifer seedlings and brush to develop. There are currently 3,320 acres of early seral coniferous forest habitat that occur within project units that will be managed as conifer plantations under Alternative 1. The removal of competing vegetation will move stands into mature forest sooner, reducing the habitat capability for quail in these areas in the long term. In the short term, cover in the form of stands of seedlings (newly planted) and young trees (11" dbh and under) will increase. This will aid in maintaining early-mid seral conifer habitat, until shrub management is no longer implemented for plantation survival (3-5+ years) and increasing mid seral habitat on these acres as early seral habit develops into larger diameter trees.

Change in Acres of CWHR Tree Sizes and Tree Canopy Closure: No tree removal will occur therefore there will be no change in tree canopy closure or CWHR size class changes in relation to removal of trees. CWHR size changes over treated areas will occur, from areas lacking trees to an increase in early seral habitat, through an increase in seedlings (<1"dbh) and saplings (1-5.9" dbh) from planting.

Acres with Change in Understory Shrub Canopy Closure: After the Freds Fire, shrubs expanded and are currently at least 4 years of age in the areas that received high intensity burning.

In areas of light or moderate burning, shrubs may have survived intact, re-sprouted, or expanded into newly created openings with the reduction in overstory tree canopy. Based upon this information, the Freds Project will reduce habitat for mountain quail following treatments, in areas with shrub removal within the treatment units. This will come from herbicide treatment over roughly 3,319 acres, though portions of these acres won't be treated due to buffers, radial treatments and avoidance areas. Shrubs across an overlap of 388 acres will be affected through mastication. It is expected that some untreated patches of shrubs will remain in the project treatment units, as well as in adjacent areas within in the original Freds Fire burn boundary that aren't within treatment units.

Cumulative Effects to Habitat in the Project Area: The project area overlaps a portion of the Freds Fire Restoration Project (which overlapped the Freds Fire boundary) in which fire salvage was completed on approximately 2,936 acres within a year. This opened up areas for further shrub establishment. This alternative would manage approximately 3,320 acres within the Freds Fire boundary as plantations (conifer dominated), increasing early and mid-seral habitat for quail, but reducing the understory shrub component within those planted areas

The possibility of a future wildfire could impact the development of mountain quail habitat in the Freds Fire Area (refer to Alternative 1 Cumulative Effects discussion for California spotted owl). Regardless of the type of fuel loading, the area has a high risk of wildfire repeating across the landscape. Treatments under this alternative would lessen the effects of wildfire. Any fire (regardless of acreage) occurring within the area project boundary that maintains areas in early seal habitat would benefit mountain quail by maintaining that area in an early seral condition.

Cumulative Effects Conclusion: Planting and vegetation control to enhance tree survival would benefit mountain quail in the short term by increasing early seral stage habitat and maintaining mid seral habitat across the 3,320 acres of areas managed as plantations. Shrub habitat types that fall within treatment unit boundaries as well as the 388 acres proposed for mastication will be converted to early seral conifer vegetation in terms of acres of habitat and, therefore, will alter the existing trend in the amount of habitat type in the project units. Although the understory shrub habitat will be altered, acres of shrubland habitat in untreated areas, as well as pockets within treated areas, in the project boundary will be retained and provide both nesting and dispersal corridors for the mountain quail.

Alternative 2 (No Action)

Direct and Indirect Effects to Habitat: This alternative will not result in any direct or indirect effects to early or mid seral coniferous habitat.

Cumulative Effects to Habitat in the Analysis Area: As there are no direct or indirect changes in existing circumstances, there will be no cumulative effects associated with this project under this alternative in regards to change in acres of early and mid seral coniferous habitat; CWHR tree sizes; tree canopy closure; or understory shrub canopy closure.

Cumulative Effects Conclusion: As there are no changes in habitat from current conditions, the No Action Alternative will not affect the existing early or mid seral coniferous habitat, nor will it lead to a change in the distribution of mountain quail across the Sierra Nevada bioregion.

Alternative 3

Direct and Indirect Effects to Habitat: Effects on mountain quail early seral coniferous habitat under Alternative 3 would be the same as described in Alternative 1 as the difference between the two alternatives is the no use of herbicides and no treatment of an additional 800 acres. This would enable understory shrub growth to be retained or develop as site conditions allow within those 800 acres, as well as outside the circular hand grubbed areas. This, however, would not create any additional acres of early seral habitat for quail unless conifers naturally regenerate within those 800 acres.

Cumulative Effects Conclusion: Planting and vegetation control to enhance tree survival would benefit mountain quail in the short term by increasing early seral stage habitat and maintaining mid seral habitat across the areas managed as plantations. Shrub habitat types that fall within treatment unit boundaries, as well as those acres proposed for mastication, will be converted to early seral conifer vegetation in terms of acres of habitat and therefore will alter the existing trend in the amount of habitat type in the project units. Although understory shrub habitat will be altered, the acres of shrubland habitat in untreated areas and as pockets within treated areas in the project boundary will be retained and provide both nesting and dispersal corridors for the mountain quail.

Summary of Mountain Quail Status and Trend at the Bioregional Scale

The ENF LRMP (as amended by the SNF MIS Amendment) requires bioregional-scale habitat and distribution population monitoring for the mountain quail; hence, the early and mid seral coniferous forest effects analysis for the Freds Project must be informed by both habitat and distribution population monitoring data. The sections below summarize the habitat and distribution population status and trend data for the mountain quail from the Sierra Nevada Forest Bioregional MIS Report (USDA 2008b).

Habitat Status and Trend: There are currently 546,000 acres of early and mid seral coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, and red fir) habitat on NFS lands in the Sierra Nevada. Within the last decade, the trend for early seral is slightly decreasing (from 9% to 5% of the acres on NFS lands) and the trend for mid seral is slightly increasing (from 21% to 25% of the acres on NFS lands).

Population Status and Trend: The mountain quail has been monitored in the Sierra Nevada at various sample locations by hunter survey, modeling, and breeding survey protocols. These data indicate that mountain quail continue to be present across the Sierra Nevada, and that the distribution of mountain quail populations is stable.

Relationship of Project-Level Habitat Impacts to Bioregional-Scale Mountain Quail Trend. The reduction in understory shrub habitat across the project area and an increase of 3,320 acres of early-mid seral habitat will not alter the existing trend in the habitat, and nor will it lead to a change in the distribution of mountain quail across the Sierra Nevada bioregion.

Short-term Uses and Long-term Productivity

The National Environmental Policy Act requires consideration of "the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity" (40 Code of Federal Regulations 1502.16).

Maintaining long-term productivity of the land is a central driving concept for National Forest management. Maintaining a diversity of native plant and animal species for the long-term is also a central concept. To this end, all proposed activities in Alternatives 1, 2, and 3 have been considered for their effect on long-term soil productivity, their effects to the beneficial uses of water, short and long-term fire threats and short and long-term effects to native forest plant and animal species, as described and discussed in this Chapter and supporting documentation in the appendices and planning record.

Alternatives 1 and 3 produce short-term effects to vegetation and wildlife habitat from vegetation management. Alternative 1 enhances long-term productivity in terms of movement toward older forest conditions and helping reduce the severity of future wildfires.

Unavoidable Adverse Effects

Implementation of any of the alternatives would result in some unavoidable adverse environmental effects. Although formation of the alternatives and mitigation measures include avoidance of some potential adverse effects, some adverse effects could occur that cannot be completely mitigated. The environmental consequences section for each resource area discusses these effects and they are summarized below.

Unknown occurrences of sensitive or special interest plants could be damaged or destroyed by activities associated with Alternatives 1 and 3, although this will be mitigated to some extent by surveys and will not result in a loss of viability for the species.

There will be a short-term risk of invasive plant spread under Alternative 1 that will be reduced long-term with forest establishment. There will be a long-term risk of invasive plant spread under Alternatives 2 and 3 from open ground potentially created by high severity fire.

No predicted future management activities will affect heritage resources. However, future wildfires will continue to degrade the integrity of these fragile heritage resources. The potential for future high severity fires is greatest under Alternatives 2 and 3.

There may be a negligible or slight short-term increase in sediment delivery to streams during storm events under all the alternatives; State standards for suspended sediment and turbidity will be met.

There will be a short-term loss of shrubland habitat under Alternatives 1 and 3, reducing habitat quality for MIS species that uses this ecosystem component (fox sparrow). Shrubland habitat in untreated areas will provide both nesting and dispersal corridors for the fox sparrow.

There will be a increase in early and mid seral habitat, but a short-term loss of the understory shrub component under Alternatives 1 and 3 for MIS species that uses this ecosystem component (mountain quail). Shrubland habitat in untreated areas will provide both nesting and dispersal corridors for mountain quail.

Animals could be exposed to some level of herbicides. While the use of herbicides has some potential for effects, the risk assessment conducted for this project indicates that the potential for adverse, health-related effects to animals would be low. The use of herbicides could indirectly affect animals to some level of risk through effects to habitat or prey, but these are also expected to be minor.

Alternatives 1 and 3 may affect individuals, but would not likely result in a trend toward Federal listing or a loss of viability for the California spotted owl, pallid bat, Townsend's big-eared bat, western red bat, western pond turtle, and foothill yellow-legged frog (Alternative 1 only).

Alternatives 2 and 3 are expected to result in unavoidable indirect impacts to resources in the Freds Reforestation area. Both alternatives will delay, to varying degrees, the development of conifer stands with desired old-forest characteristics. Under both Alternative 2 (no vegetation management) and Alternative 3 (radius hand release) fuel loading is expected to increase as brush continues to grow and become decadent over time, thereby extending the period at which conifer seedlings are at risk from a catastrophic stand replacing fire.

Because various elements within ecosystems are linked to each other, activities proposed in this project may affect fungi, bacteria, and a variety of other ecosystem processes, but these effects are expected to be minor. Bacteria are known to break down herbicides into harmless substances without any detrimental effects. The activities included in this project have been conducted for numerous decades without any apparent substantial adverse impacts on those components of the environment.

Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources are those that cannot be regained, such as the extinction of a species or the removal of mined ore. Irretrievable commitments are those that are lost for a period of time such as the loss of timber productivity in forested areas that are kept clear for use as a road.

An irretrievable loss of mature forest would occur if Alternative 2 were selected. This no-action alternative, which defers reforestation and release on the project, would result in delayed establishment of a mixed conifer forest. Related to this, wildlife that favor late seral stage conifer forests are likewise affected.

An irretrievable loss of mature forest would occur if Alternative 3 were selected. This alternative, which reduces reforestation by 800 acres from Alternative 1, and utilizes manual release methods, would result in fewer acres of established forest, and delayed growth of a mixed conifer forest. Related to this, wildlife that favor late seral stage conifer forests are likewise affected.

Cumulative Effects

Cumulative effects are addressed for each resource area in the environmental consequences section.

Other Required Disclosures

Protection of cultural resource sites will comply with the Programmatic Agreement among the USDA Forest Service, Pacific Southwest Region, California State Historic Preservation Officer, and Advisory Council on Historic Preservation Office Regarding the Identification, Evaluation and Treatment of Historic Properties Managed by the National Forest of the Sierra Nevada, California dated 1996 (PA).

No threatened, endangered or proposed species occur within the project area and the project is expected to have no effect on threatened, endangered or proposed species outside of the project area. Formal consultation with the USFWS was therefore unnecessary.

Compliance with the Environmental Justice Act

In February 1994, President Clinton signed an Executive Order on environmental justice, requiring federal agencies to conduct activities related to human health and the environment in a manner that does not discriminate or have the effect of discriminating against low-income or minority populations. Although low-income and minority populations live in the vicinity, activities proposed for the Freds Fire Reforestation project would not discriminate against these groups. Based on the composition of the affected communities and the cultural and economic factors, the activities that are proposed would have no disproportionately adverse effects to human health and safety or environmental effects to minorities, low income, or any other segments of the population. Scoping was conducted to elicit comments on the proposed action from all potentially interested and affected individuals and groups without regard to income or minority status.